# SRI MANAKULA VINAYAGAR
# ENGINEERING COLLEGE
**(An Autonomous Institution)**

Puducherry

## B.TECH.

## INSTRUMENTATION AND CONTROL ENGINEERING

## ACADEMIC REGULATIONS 2023
## (R-2023)

## CURRICULUM AND SYLLABI
## VOLUME 4

## COLLEGE VISION AND MISSION

### Vision

To be globally recognized for excellence in quality education, innovation, and research for the transformation of lives to serve the society.

### Mission

**M1: Quality Education**: To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

**M2**: **Research and Innovation**: To foster value- based research and innovation in collaboration with industries and Institutions globally for creating intellectuals with new avenues.

**M3: Employability and Entrepreneurship:** To inculcate the employability and entrepreneurial skills through value and skill based training.

**M4: Ethical Values**: To Instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

## DEPARTMENT VISION AND MISSION

### Vision

To provide quality education, training and research in the area of Instrumentation and Control Engineering to meet the industrial and societal needs with ethical values.

### Mission

**M1: Quality education**: To impart technical knowledge, leadership and managerial skills to meet the current industrial and societal needs.

**M2: Research and Innovation:** To foster innovation, research and development for the benefit of global community.

**M3: Employability and Entrepreneurship**: To enhance the employability skills and inculcate entrepreneurial attitude.

**M4: Ethical Values:** To provide extension services to rural society and instill ethical values among the students.

## PROGRAMME OUTCOMES (POs)

**PO1: Engineering knowledge:**

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

**PO2: Problem analysis:**

Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions:**

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

**PO4: Conduct investigations of complex problems:**

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

**PO5**: **Modern tool usage:**

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

**PO6: The engineer and society:**

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

**PO7: Environment and sustainability:**

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

**PO8: Ethics:**

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work:**

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication:**

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

**PO11: Project management and finance:**

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

**PO12: Life-long learning:**

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

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**PEO 1: Core Competency:**

Solve real-life engineering problems, design and development of innovative and cost-effective products exhibiting a solid foundation in Instrumentation and Control Engineering fundamentals to cater needs of society.

**PEO 2: State of the art technology:**

To impart state of the art technology to the students in the field of Instrumentation and Control Engineering to meet the industrial needs.

**PEO 3: Multi-disciplinary skills:**

To develop Multi-disciplinary skills and acquire leadership qualities along with professional and ethical values.

**PEO 4: Innovation and entrepreneurship:**

To promote innovation and entrepreneurship in designing and developing instrumentation systems to address social and technical challenges.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

**PSO1: Basic Knowledge in ICE:**

Apply the knowledge of Instrumentation and Control Engineering to relate the fundamental concepts of Instrumentation (measurement, control, operation, monitoring and maintenance) to varied measurement systems and models.

**PSO2: Advanced Tools for industrial automation:**

Apply the knowledge of hardware and software tools for industrial automation systems

**PSO3: Design and development of Instrumentation systems:**

Ability to design and develop instrumentation systems to solve real time applications.

## STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAMME

| Sl. No | Course Category | Breakdown of Credits |
|---|---|---|
| 1 | Humanities and Social Sciences including Management courses (HS) | 15 |
| 2 | Basic Science Courses (BS) | 20 |
| 3 | Engineering Science Courses (ES) | 28 |
| 4 | Professional Core Courses (PC) | 67 |
| 5 | Professional Elective Courses (PE) | 18 |
| 6 | Open Elective Courses (OE) | 9 |
| 7 | Project Work and Internship (PA) | 13 |
| 8 | Ability Enhancement Courses (AEC*) | - |
| 9 | Mandatory Courses (MC*) | - |
| **Total** | | **170** |

## SCHEME OF CREDIT DISTRIBUTION – SUMMARY

| Sl. No | AICTE Suggested Course Category | Credits per Semester | | | | | | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | |
| 1 | Humanities and Social Science Courses (HS) | 3 | 5 | 1 | 1 | 2 | - | - | 3 | 15 |
| 2 | Basic Science Courses (BS) | 7 | 4 | 5 | 4 | - | - | - | - | 20 |
| 3 | Engineering Science Courses (ES) | 8 | 5 | 4 | 7 | 4 | - | - | - | 28 |
| 4 | Professional Core Courses (PC) | 4 | 8 | 13 | 8 | 8 | 15 | 11 | - | 67 |
| 5 | Professional Elective Courses (PE) | - | - | - | 3 | 3 | 3 | 3 | 6 | 18 |
| 6 | Open Elective Courses (OE) | - | - | - | - | 3 | 3 | 3 | - | 09 |
| 7 | Project Work (PA) | - | - | - | - | 1 | 1 | 2 | 8 | 12 |
| 8 | Internship (PA) | - | - | - | - | - | - | 1 | - | 01 |
| 9 | Ability Enhancement courses (AEC*) Courses (AEC*) | - | - | - | - | - | - | - | - | - |
| 10 | Mandatory Courses (MC*) | - | - | - | - | - | - | - | - | - |
| **Total** | | **22** | **22** | **23** | **23** | **21** | **22** | **20** | **17** | **170** |

**** AEC and MC are not included for CGPA calculation***

### HONOURS / MINOR DEGREE PROGRAMME:

The student is permitted to opt for earning an honours / minor degree in the same discipline of engineering in addition to the degree in his/her own discipline. To earn an honours / minor degree the student is required to earn an additional 18 - 20 credits (over and above the total 170 credits prescribed in the curriculum) starting from fourth semester onwards by completing 5 additional courses offered in respective semesters. A student is eligible to exercise this option if he/she has passed all the courses offered upto third semester in the first attempt itself and has earned a CGPA / GPA* (*for lateral entry) of not less than 8.0. The prescribed courses offered for Honours / minor degree are given in **Annexure V**.

| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | CAM | ESM | Total |
| **SEMESTER – I** | | | | | | | | | | |
| **Theory** | | | | | | | | | | |
| 1 | U23MATC01 | Engineering Mathematics - I | BS | 3 | 1 | 0 | 4 | 25 | 75 | 100 |
| 2 | U23BSTC01 | Physical Science for Engineers | BS | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23ESTC01 | Basics of Civil and Mechanical Engineering | ES | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 4 | U23CSTC02 | Problem Solving Approach | ES | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | U23ICT101 | Fundamentals of Electrical Machines | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Theory cum Practical** | | | | | | | | | | |
| 6 | U23ENBC01 | Communicative English - I | HS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| **Practical** | | | | | | | | | | |
| 7 | U23ESPC02 | Design Thinking and IDEA Lab | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 8 | U23ICP101 | Problem Solving Approach Laboratory | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 9 | U23ICP102 | Fundamentals of Electrical Machines Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Ability Enhancement Course** | | | | | | | | | | |
| 10 | U23ICC1XX | Certification Course I** | AEC | 0 | 0 | 4 | - | 100 | - | 100 |
| **Mandatory Course** | | | | | | | | | | |
| 11 | U23ICM101 | Induction Programme | MC | 2 Weeks | | | - | - | - | - |
| | | | | | | | 22 | 425 | 575 | 1000 |

| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | CAM | ESM | Total |
| **SEMESTER – II** | | | | | | | | | | |
| **Theory** | | | | | | | | | | |
| 1 | U23MATC02 | Engineering Mathematics - II | BS | 3 | 1 | 0 | 4 | 25 | 75 | 100 |
| 2 | U23CSTC01 | Programming in C | ES | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23BMTC01 | Electron Devices and Circuits | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 4 | U23ICT202 | Transducer Engineering | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | U23HSTC01 | Universal Human Values - II | HS | 2 | 0 | 0 | 2 | 25 | 75 | 100 |
| **Theory cum Practical** | | | | | | | | | | |
| 6 | U23ENBC02 | Communicative English - II | HS | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| **Practical** | | | | | | | | | | |
| 7 | U23ESPC03 | Engineering Graphics using AutoCAD | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 8 | U23CSPC01 | Programming in C Laboratory | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 9 | U23BMPC01 | Electron Devices and Circuits Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 10 | U23ICP203 | Transducer Engineering Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Ability Enhancement Course** | | | | | | | | | | |
| 11 | U23ICC2XX | Certification Course II** | AEC | 0 | 0 | 4 | - | 100 | - | 100 |
| **Mandatory Course** | | | | | | | | | | |
| 12 | U23ICM202 | Sports Yoga and NSS | MC | 0 | 0 | 2 | - | 100 | - | 100 |
| | | | | | | | 22 | 575 | 625 | 1200 |

***** Certification Courses are to be selected from the list given in Annexure III***

| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | CAM | ESM | Total |
| **SEMESTER – III** | | | | | | | | | | |
| **Theory** | | | | | | | | | | |
| 1 | U23MATC03 | Probability and Statistics | BS | 3 | 1 | 0 | 4 | 25 | 75 | 100 |
| 2 | U23ADTC01 | Programming in Python | ES | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23ICTC01 | Linear Integrated Circuits | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 4 | U23ICTC02 | Digital Logic Circuits | PC | 2 | 1 | 0 | 3 | 25 | 75 | 100 |
| 5 | U23ICT303 | Electrical and Electronic Instrumentation | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Theory cum Practical** | | | | | | | | | | |
| 6 | U23ICB301 | Circuit Theory | PC | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| **Practical** | | | | | | | | | | |
| 7 | U23ENPC01 | General Proficiency - I | HS | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 8 | U23MAPC01 | Engineering Mathematics Laboratory | BS | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 9 | U23ADPC01 | Programming in Python Laboratory | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 10 | U23ICPC01 | Linear and Digital Integrated Circuits Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Ability Enhancement Course** | | | | | | | | | | |
| 11 | U23ICC3XX | Certification Course III** | AEC | 0 | 0 | 4 | - | 100 | - | 100 |
| 12 | U23ICS301 | Skill Enhancement Course I* | AEC | 0 | 0 | 2 | - | 100 | - | 100 |
| **Mandatory Course** | | | | | | | | | | |
| 13 | U23ICM303 | Climate Change | MC | 2 | 0 | 0 | - | 100 | - | 100 |
| | | | | | | | 23 | 675 | 625 | 1300 |

| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | CAM | ESM | Total |
| **SEMESTER – IV** | | | | | | | | | | |
| **Theory** | | | | | | | | | | |
| 1 | U23MATC04 | Numerical Methods and Optimization | BS | 3 | 1 | 0 | 4 | 25 | 75 | 100 |
| 2 | U23CSTC03 | Data Structures | ES | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23ICTC03 | Linear Control Systems | PC | 2 | 1 | 0 | 3 | 25 | 75 | 100 |
| 4 | U23ICT404 | Microcontroller Based System Design | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | U23ICE4XX | Professional Elective I # | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Theory cum Practical** | | | | | | | | | | |
| 6 | U23ICB402 | Solid and Fluid Mechanics | ES | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| **Practical** | | | | | | | | | | |
| 7 | U23ENPC02 | General Proficiency - II | HS | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 8 | U23CSPC02 | Data Structures Laboratory | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 9 | U23ICP404 | Microcontroller Based System Design Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 10 | U23ICP405 | Simulation Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Ability Enhancement Course** | | | | | | | | | | |
| 11 | U23ICC4XX | Certification Course IV** | AEC | 0 | 0 | 4 | - | 100 | - | 100 |
| 12 | U23ICS402 | Skill Enhancement Course II* | AEC | 0 | 0 | 2 | - | 100 | - | 100 |
| **Mandatory Course** | | | | | | | | | | |
| 13 | U23ICM404 | Right to Information and Good Governance | MC | 2 | 0 | 0 | - | 100 | - | 100 |
| | | | | | | | 23 | 675 | 625 | 1300 |

***# Professional Electives are to be selected from the list given in Annexure I***

**** Skill Enhancement Courses (1 and 2) are to be selected from the list given in Annexure IV***

| | SEMESTER – V | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
| | | | | L | T | P | | CAM | ESM | Total |
| **Theory** | | | | | | | | | | |
| 1 | U23HSTC02 | Research Methodology | HS | 2 | 0 | 0 | 2 | 25 | 75 | 100 |
| 2 | U23ITTC02 | Programming in Java | ES | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23ICT505 | Industrial Instrumentation | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 4 | U23ICT506 | Embedded System Design | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | U23ICE5XX | Professional Elective II # | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 6 | U23XXOCXX | Open Elective I $ | OE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Practical** | | | | | | | | | | |
| 7 | U23ITPC02 | Programming in Java Laboratory | ES | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 8 | U23ICP506 | Embedded System Design Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 9 | U23ICP507 | Industrial Instrumentation Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Project Work** | | | | | | | | | | |
| 10 | U23ICW501 | Micro Project | PA | 0 | 0 | 2 | 1 | 100 | - | 100 |
| **Ability Enhancement Course** | | | | | | | | | | |
| 11 | U23ICC5XX | Certification Course V** | AEC | 0 | 0 | 4 | - | 100 | - | 100 |
| **Mandatory Course** | | | | | | | | | | |
| 12 | U23ICM505 | Essence of Indian Traditional Knowledge | MC | 2 | 0 | 0 | - | 100 | - | 100 |
| | | | | | | | 21 | 600 | 600 | 1200 |

| | SEMESTER – VI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
| | | | | L | T | P | | CAM | ESM | Total |
| **Theory** | | | | | | | | | | |
| 1 | U23ICT607 | Analytical Instrumentation | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 2 | U23ICT608 | Power Plant Instrumentation | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23ICT609 | Process Control | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 4 | U23ICE6XX | Professional Elective III # | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | U23XXOCXX | Open Elective II $ | OE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Theory cum Practical** | | | | | | | | | | |
| 6 | U23ICB603 | Internet of Things for Automation | PC | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| **Practical** | | | | | | | | | | |
| 7 | U23ICP608 | Instrumentation System Design Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 8 | U23ICP609 | Process Control Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 9 | U23ICP610 | Virtual Instrumentation Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| **Project Work** | | | | | | | | | | |
| 10 | U23ICW602 | Mini Project | PA | 0 | 0 | 2 | 1 | 100 | - | 100 |
| **Ability Enhancement Course** | | | | | | | | | | |
| 11 | U23ICC6XX | Certification Course VI** | AEC | 0 | 0 | 4 | - | 100 | - | 100 |
| **Mandatory Course** | | | | | | | | | | |
| 12 | U23ICM606 | Gender Equality | MC | 2 | 0 | 0 | - | 100 | - | 100 |
| | | | | | | | 22 | 625 | 575 | 1200 |

***$ Open Electives are to be selected from the list given in Annexure II***

| | SEMESTER – VII | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
| | | | | L | T | P | | CAM | ESM | Total |
| **Theory** | | | | | | | | | | |
| 1 | U23ICT710 | Industrial Safety | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 2 | U23ICT711 | Instrumentation in Biomedical Applications | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23ICT712 | Logic and Distributed Control System | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 4 | U23ICE7XX | Professional Elective IV # | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | U23XXOCXX | Open Elective III $ | OE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Practical** | | | | | | | | | | |
| 6 | U23ICP711 | Logic and Distributed Control System Laboratory | PC | 0 | 0 | 2 | 1 | 50 | 50 | 100 |
| 7 | U23ICP712 | Technical Seminar | PC | 0 | 0 | 2 | 1 | 100 | - | 100 |
| **Project Work** | | | | | | | | | | |
| 8 | U23ICW703 | Project Phase I | PA | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| 9 | U23ICW704 | Internship / Inplant Training | PA | 0 | 0 | 2 | 1 | 100 | - | 100 |
| | | | | | | | 20 | 425 | 475 | 900 |

| | SEMESTER – VIII | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
| | | | | L | T | P | | CAM | ESM | Total |
| **Theory** | | | | | | | | | | |
| 1 | U23HSTC03 | Entrepreneurship and Business Management | HS | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 2 | U23ICE8XX | Professional Elective V # | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | U23ICE8XX | Professional Elective VI # | PE | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| **Project Work** | | | | | | | | | | |
| 4 | U23ICW805 | Project Phase II | PA | 0 | 0 | 16 | 8 | 50 | 100 | 150 |
| | | | | | | | 17 | 125 | 325 | 450 |
| **Total Credits** | | | | | | | **170** | | | |

## Annexure – I

### PROFESSIONAL ELECTIVE COURSES

| Professional Elective – I (Offered in Semester IV) | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U23BMEC01 | Communication Systems |
| 2 | U23ICE401 | Energy Harvesting Techniques |
| 3 | U23ICE402 | Fundamentals of Computer Networks |
| 4 | U23ICE403 | Fundamentals of Pneumatics and Hydraulics |
| 5 | U23ICE404 | Signal Processing for Instrumentation |
| **Professional Elective – II (Offered in Semester V)** | | |
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U23ICE505 | Calibration Systems |
| 2 | U23ICE506 | Industrial Unit Operations |
| 3 | U23ICE507 | Instrumentation Buses and Data Networks |
| 4 | U23ICE508 | Instrumentation Symbols and Standards |
| 5 | U23ICE509 | Software Design Tools for Sensing and Control |
| **Professional Elective – III (Offered in Semester VI)** | | |
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U23ICEC01 | Virtual Instrumentation |
| 2 | U23ICEC02 | Soft Computing Techniques |
| 3 | U23ICE610 | MEMS and NEMS |
| 4 | U23ICE611 | Non-Linear Control Systems |
| 5 | U23ICE612 | Piping and Instrumentation Diagram |
| **Professional Elective – IV (Offered in Semester VII)** | | |
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U23ICEC03 | Intelligent Robotic Systems |
| 2 | U23ICE713 | Computer Control of Processes |
| 3 | U23ICE714 | Fiber Optics and Laser Instrumentation |
| 4 | U23ICE715 | Instrumentation in Process Industries |
| 5 | U23ICE716 | Safety Instrumented System |
| **Professional Elective – V (Offered in Semester VIII)** | | |
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U23BMEC02 | Wearable Technology |
| 2 | U23ICE817 | Design of Process Control System Components |
| 3 | U23ICE818 | Green Electronics |
| 4 | U23ICE819 | Instrumentation in Petrochemical Industries |

| | | |
|---|---|---|
| 5 | U23ICE820 | Pharmaceutical Instrumentation |
| **Professional Elective – VI (Offered in Semester VIII)** | | |
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U23ICE821 | Automotive Instrumentation and Control |
| 2 | U23ICE822 | Cybersecurity in Industrial Automation |
| 3 | U23ICE823 | Instrumentation and Control for Paper Industries |
| 4 | U23ICE824 | Instrumentation in Agriculture and Food Processing Industries |
| 5 | U23ICE825 | System Identification and Adaptive Control |

## Annexure - II

### OPEN ELECTIVE COURSES

| **Open Elective- I (Offered in Semester V/ VI)** | | | | |
|---|---|---|---|---|
| **S. No** | **Course Code** | **Course Title** | **Offering Department** | **Offered Department** |
| **Open Elective – I/ Open Elective – II**<br>(Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**)<br>(Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, CSE &BS**) | | | | |
| 1 | U23ICOC01 | Neural Networks and Fuzzy Logic | ICE | CSE, IT, MECH, CCE, CSE&BS, AI&DS |
| 2 | U23ICOC02 | Sensors for Engineering Applications | ICE | EEE, ECE, CSE, IT, MECH, CCE, CSE&BS, AI&DS |
| **Open Elective- III (Offered in Semester VII)** | | | | |
| 1 | U23ICOC03 | Artificial Intelligence in Automation | ICE | EEE, ECE, CSE, IT, MECH, Mechatronics, CCE, CSE&BS, AI&DS |
| 2 | U23ICOC04 | Embedded Systems for AI Applications | ICE | CSE, IT, BME, CCE, CSE&BS, AI&DS |

## Annexure – III

### ABILITY ENHANCEMENT COURSES – CERTIFICATION COURSES

| S. No | Course Code | Course Title | Certified By |
|---|---|---|---|
| 1 | U23ICCX01 | Adobe Photoshop | Adobe |
| 2 | U23ICCX02 | Adobe Animate | Adobe |
| 3 | U23ICCX03 | Adobe Dreamweaver | Adobe |
| 4 | U23ICCX04 | Adobe After Effects | Adobe |
| 5 | U23ICCX05 | Adobe Illustrator | Adobe |
| 6 | U23ICCX06 | Adobe InDesign | Adobe |
| 7 | U23ICCX07 | Autodesk AutoCAD -ACU | Autodesk |
| 8 | U23ICCX08 | Autodesk Inventor - ACU | Autodesk |
| 9 | U23ICCX09 | Autodesk Revit - ACU | Autodesk |
| 10 | U23ICCX10 | Autodesk Fusion 360 - ACU | Autodesk |
| 11 | U23ICCX11 | Autodesk 3ds Max - ACU | Autodesk |
| 12 | U23ICCX12 | Autodesk Maya - ACU | Autodesk |
| 13 | U23ICCX13 | Cloud Security Foundations | AWS |
| 14 | U23ICCX14 | Cloud Computing Architecture | AWS |
| 15 | U23ICCX15 | Cloud Foundation | AWS |
| 16 | U23ICCX16 | Cloud Practitioner | AWS |
| 17 | U23ICCX17 | Cloud Solution Architect | AWS |
| 18 | U23ICCX18 | Data Engineering | AWS |
| 19 | U23ICCX19 | Machine Learning Foundation | AWS |
| 20 | U23ICCX20 | Robotic Process Automation / Medical Robotics | Blue Prism |
| 21 | U23ICCX21 | Advance Programming Using C | CISCO |
| 22 | U23ICCX22 | Advance Programming Using C ++ | CISCO |
| 23 | U23ICCX23 | C Programming | CISCO |
| 24 | U23ICCX24 | C++ Programming | CISCO |
| 25 | U23ICCX25 | CCNP Enterprise: Advanced Routing | CISCO |
| 26 | U23ICCX26 | CCNP Enterprise: Core Networking | CISCO |
| 27 | U23ICCX27 | Cisco Certified Network Associate - Level 2 | CISCO |
| 28 | U23ICCX28 | Cisco Certified Network Associate- Level 1 | CISCO |
| 29 | U23ICCX29 | Cisco Certified Network Associate- Level 3 | CISCO |
| 30 | U23ICCX30 | Fundamentals Of Internet of Things | CISCO |
| 31 | U23ICCX31 | Internet Of Things / Solar and Smart Energy System with IoT | CISCO |
| 32 | U23ICCX32 | Java Script Programming | CISCO |
| 33 | U23ICCX33 | NGD Linux Essentials | CISCO |
| 34 | U23ICCX34 | NGD Linux I | CISCO |
| 35 | U23ICCX35 | NGD Linux II | CISCO |
| 36 | U23ICCX36 | Advance Java Programming | Ethnotech |
| 37 | U23ICCX37 | Android Programming / Android Medical App Development | Ethnotech |
| 38 | U23ICCX38 | Angular JS | Ethnotech |
| 39 | U23ICCX39 | Catia | Ethnotech |
| 40 | U23ICCX40 | Communication Skills for Business | Ethnotech |
| 41 | U23ICCX41 | Coral Draw | Ethnotech |
| 42 | U23ICCX42 | Data Science Using R | Ethnotech |
| 43 | U23ICCX43 | Digital Marketing | Ethnotech |
| 44 | U23ICCX44 | Embedded System Using C | Ethnotech |

| | | | |
|---|---|---|---|
| 45 | U23ICCX45 | Embedded System with IOT / Arduino | Ethnotech |
| 46 | U23ICCX46 | English For IT | Ethnotech |
| 47 | U23ICCX47 | Plaxis | Ethnotech |
| 48 | U23ICCX48 | Sketch Up | Ethnotech |
| 49 | U23ICCX49 | Financial Planning, Banking and Investment Management | Ethnotech |
| 50 | U23ICCX50 | Foundation Of Stock Market Investing | Ethnotech |
| 51 | U23ICCX51 | Machine Learning / Machine Learning for Medical Diagnosis | Ethnotech |
| 52 | U23ICCX52 | IOT Using Python | Ethnotech |
| 53 | U23ICCX53 | Creo (Modelling & Simulation) | Ethnotech |
| 54 | U23ICCX54 | Soft Skills, Verbal, Aptitude | Ethnotech |
| 55 | U23ICCX55 | Software Testing | Ethnotech |
| 56 | U23ICCX56 | MX-Road | Ethnotech |
| 57 | U23ICCX57 | CLO 3D | Ethnotech |
| 58 | U23ICCX58 | Solid works | Ethnotech |
| 59 | U23ICCX59 | Staad Pro | Ethnotech |
| 60 | U23ICCX60 | Total Station | Ethnotech |
| 61 | U23ICCX61 | Hydraulic Automation | Festo |
| 62 | U23ICCX62 | Industrial Automation | Festo |
| 63 | U23ICCX63 | Pneumatics Automation | Festo |
| 64 | U23ICCX64 | Agile Methodologies | IBM |
| 65 | U23ICCX65 | Block Chain | IBM |
| 66 | U23ICCX66 | Devops | IBM |
| 67 | U23ICCX67 | Artificial Intelligence | ITS |
| 68 | U23ICCX68 | Cloud Computing | ITS |
| 69 | U23ICCX69 | Computational Thinking | ITS |
| 70 | U23ICCX70 | Cyber Security | ITS |
| 71 | U23ICCX71 | Data Analytics | ITS |
| 72 | U23ICCX72 | Databases | ITS |
| 73 | U23ICCX73 | Java Programming | ITS |
| 74 | U23ICCX74 | Networking | ITS |
| 75 | U23ICCX75 | Python Programming | ITS |
| 76 | U23ICCX76 | Web Application Development (HTML, CSS, JS) | ITS |
| 77 | U23ICCX77 | Network Security | ITS & Palo alto |
| 78 | U23ICCX78 | MATLAB | MathWorks |
| 79 | U23ICCX79 | Azure Fundamentals | Microsoft |
| 80 | U23ICCX80 | Azure AI (AI-900) | Microsoft |
| 81 | U23ICCX81 | Azure Data (DP -900) | Microsoft |
| 82 | U23ICCX82 | Microsoft 365 Fundamentals (SS-900) | Microsoft |
| 83 | U23ICCX83 | Microsoft Security, Compliance and Identity (SC-900) | Microsoft |
| 84 | U23ICCX84 | Microsoft Power Platform (PI-900) | Microsoft |
| 85 | U23ICCX85 | Microsoft Dynamics Fundamentals 365 – CRM | Microsoft |
| 86 | U23ICCX86 | Microsoft Excel | Microsoft |
| 87 | U23ICCX87 | Microsoft Excel Expert | Microsoft |
| 88 | U23ICCX88 | Securities Market Foundation | NISM |
| 89 | U23ICCX89 | Derivatives Equinity | NISM |
| 90 | U23ICCX90 | Research Analyst | NISM |
| 91 | U23ICCX91 | Portfolio Management Services | NISM |
| 92 | U23ICCX92 | Cyber Security | Palo alto |

| | | | |
|---|---|---|---|
| 93 | U23ICCX93 | Cloud Security | Palo alto |
| 94 | U23ICCX94 | PMI – Ready | PMI |
| 95 | U23ICCX95 | Tally – GST & TDS | Tally |
| 96 | U23ICCX96 | Advance Tally | Tally |
| 97 | U23ICCX97 | Associate Artist | Unity |
| 98 | U23ICCX98 | Certified Unity Programming | Unity |
| 99 | U23ICCX99 | VR Development | Unity |

## Annexure – IV

### ABILITY ENHANCEMENT COURSES – SKILL ENHANCEMENT COURSES (SEC)

| Sl. No | Course Code | Course Title |
|---|---|---|
| 1. | U23ICS301 | **Skill Enhancement Course 1 *** |
| | | • Troubleshooting of Electronic Equipments |
| | | • Calibration of Measuring Instruments |
| | | • Application of Arduino |
| 2. | U23ICS402 | **Skill Enhancement Course 2 *** |
| | | • Applications using Raspberry Pi |
| | | • PLC Programming |
| | | • AutoCAD for Instrumentation |

**** Any one Skill Enhancement course to be selected from SEC 1 and SEC 2.***

## Annexure – V

### HONOURS / MINOR PROGRAMME - SENSORS TECHNOLOGY

| COURSE DETAILS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | Semester | Course Code | Course Title | Category | Periods | | | Credits | Max. Marks | | |
| | | | | | L | T | P | | CAM | ESM | Total |
| **Theory** | | | | | | | | | | | |
| 1 | IV | U23SXB401 | Smart Sensors | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 2 | V | U23SXT502 | Nano Biosensors* | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | VI | U23SXB603 | Embedded Sensing Technologies | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 4 | VII | U23SXT704 | IoT and Sensor Networks* | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | VIII | U23SXT805 | Wearable Devices and its Applications* | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 6 | VIII | U23SXW806 | Project / Model Making | PA | 0 | 0 | 4 | 2 | 100 | - | 100 |
| | **Total** | | | | | | | **19** | **275** | **325** | **600** |
| **Equivalent NPTEL courses[##]** | | | | | | | | | | | |
| 1 | IV to VII Semester | U23XXXN01 | Sensors Technology Equivalent NPTEL Courses | | | | | 3 | 12 Week Course | | |

[##] The student shall be given an option to earn 3 credits through one equivalent 12 week NPTEL course instead of any one course listed for honours / minor degree programme that should be completed before the commencement of eighth semester. The equivalent courses are subject to change based on its availability as per NPTEL course list.

## *List of NPTEL Courses

1. Sensors and Actuators
2. Biophotonics
3. Embedded Systems Design
4. Introduction to Industry 4.0 and Industrial Internet of Things
5. Microsensors, Implantable Devices and Rodent Surgeries for Biomedical Applications

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Mathematics** | Programme: **B.Tech.** | | | | | | |
| Semester | **I** | Course Category: **BS** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23MATC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Engineering Mathematics – I** | **3** | **1** | **0** | **4** | **25** | **75** | **100** |

(Common to ALL Branches Except CSBS)

| | | | |
|---|---|---|---|
| Prerequisite | Basic Mathematics | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Understand the concept of Eigen values and Eigen vectors, Diagonalization of a Matrix | **K3** |
| | **CO2** | Solve higher order differential equations | **K3** |
| | **CO3** | Understand the different types of partial differential equations | **K3** |
| | **CO4** | Know about the Applications of double and triple integrals | **K3** |
| | **CO5** | Gain the knowledge about Vector Calculus and its Applications | **K3** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Matrices** | **Periods:12** | |
| Rank of a Matrix – Systems of Linear Equations – Characteristic equation – Cayley Hamilton Theorem – Eigen values and Eigen vectors of a real Matrix – Diagonalization of Matrices. | | | **CO1** |
| **UNIT – II** | **Differential Equations (Higher Order)** | **Periods:12** | |
| Linear Differential equations of higher order with constant coefficients – Euler's linear equation of higher order with variable coefficients – Method of Variation of parameters. | | | **CO2** |
| **UNIT – III** | **Functions Of Several Variables** | **Periods:12** | |
| Partial derivatives – Total derivatives – Maxima and Minima of two variables – Lagrange's Method of multipliers. | | | **CO3** |
| **UNIT – IV** | **Multiple Integrals** | **Periods:12** | |
| Multiple Integrals – Change of order of integration (Cartesian form). Applications: Area as a double integral (Cartesian form) – Volume as a triple integral (Cartesian form). | | | **CO4** |
| **UNIT – V** | **Vector Calculus** | **Periods:12** | |
| Gradient – Divergence and Curl – Directional derivatives – Irrotational and Solenoidal vector fields – Properties (Statement only) – Gauss Divergence Theorem and Stoke's Theorem (without proofs). | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods: 45** | **Tutorial Periods: 15** | **Practical Periods: -** | **Total Periods: 60** |

**Text Books**

1. M.K. Venkataraman, "Engineering Mathematics", The National Publishing Company, 2nd Edition, 2016.
2. N. P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9th Edition, 2018.
3. S.Narayanan and T.K. Manickavasagam Pillay," Differential Equations and its Applications", Viswanathan. S, Printers & Publishers Pvt Ltd, 2009.

**Reference Books**

1. G. Balaji, "Matrices and Calculus (Engineering Mathematics – I)" Balaji Publications, 9th Edition June 2023
2. A. Singaravelu, "Engineering Mathematics – I", Meenakshi publications, 1998.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", Wiley, 10th Edition, 2019.
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
5. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3rd Edition, 2019.

**Web References**

1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra –slides- systems of equation-handout.pdf
2. http://www.math.cum.edu/~wn0g/2ch6a.pdf
3. https://nptel.ac.in/courses/122/104/122104017/
4. https://nptel.ac.in/courses/111/106/111106051/
5. https://nptel.ac.in/courses/111/108/111108081/

* TE – Theory Exam, LE – Lab Exam

Department of Instrumentation and Control Engineering

Dr. L. M. Varalakshmi

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 1 | - | 2 | 1 | 1 | - | - | - | - | 1 | 3 | - | - |
| **2** | 3 | 2 | 1 | 1 | - | 1 | 1 | - | - | - | - | 1 | 3 | - | - |
| **3** | 3 | 2 | 1 | 1 | - | 1 | 1 | - | - | - | - | 1 | 3 | - | - |
| **4** | 3 | 2 | 1 | 1 | - | 1 | 1 | - | - | - | - | 1 | 3 | - | - |
| **5** | 2 | 2 | 1 | - | - | - | 1 | - | - | - | - | 1 | 3 | - | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Physics / Chemistry** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **I / II** | Course Category: **BS** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23BSTC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Physical Science for Engineers** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to all Branches)

| Prerequisite | Physics of 12th standard or equivalent / Chemistry of 12th standard or equivalent. | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Understand the basic of properties of magnetic, dielectric and superconductors. | **K2** |
| | **CO2** Identify the wave nature of the particles, physical significance of wave functions | **K3** |
| | **CO3** Understand the basic principles of laser and fiber optics communication | **K2** |
| | **CO4** Understand and familiar with the water treatment. | **K2** |
| | **CO5** Understand the electrode potential for its feasibility in electrochemical reaction and uses of various batteries. | **K2** |
| | **CO6** Understand the specific operating condition under which corrosion occurs and suggest a method to control corrosion. | **K2** |

**SECTION A - PHYSICS**

| **UNIT-I** | **Magnetic, Dielectric and Superconducting Materials** | **Periods: 8** | |
|---|---|---|---|
| Introduction to magnetic materials, Ferromagnetism- Domain Theory-Types of energy-Hysteresis-Hard and Soft magnetic materials-ferrites-Dielectric materials -Types of polarization – Langevin-Debye equation -Frequency effects on polarization-Dielectric breakdown- Ferroelectric materials -Superconducting materials and their properties. | | | **CO1** |
| **UNIT-II** | **Quantum Mechanics** | **Periods: 7** | |
| Matter Waves - de Broglie Wavelength - Uncertainty Principle –Physical Significance of wave functions - Schrodinger wave Equation - Time Dependent - Time Independent - Application to Particle in a One Dimensional Box - Tunnel Diode. | | | **CO2** |
| **UNIT-III** | **Laser And Fiber Optics** | **Periods: 7** | |
| Lasers - Principles of Laser - Spontaneous and Stimulated Emissions - Einstein's Coefficients - Population Inversion and Laser Action –components of laser - Types of Lasers - NdYAG, $CO_2$ laser, GaAs Laser Fiber Optics - Principle and Propagation of light in optical fiber - Numerical aperture and acceptance angle - Types of optical fibers (material, refractive index, mode) | | | **CO3** |

**SECTION B – CHEMISTRY**

| **UNIT-IV** | **Water And Its Treatment** | **Periods: 8** | |
|---|---|---|---|
| Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD. Desalination of brackish water: Reverse osmosis-disadvantages of using hard water in boiler - Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment–Ion exchange demineralization and zeolite process. | | | **CO4** |
| **UNIT-V** | **Electrochemical Cells and Storage Devices** | **Periods: 8** | |
| Galvanic cells, single electrode potential, standard electrode potential, electrochemical series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen, calomel and Ag/AgCl. Batteries and fuel cells: Types of batteries- alkaline battery-lead storage battery- nickel-cadmium battery- fuel cell $H_2$ -$O_2$ fuel cell-applications. | | | **CO5** |
| **UNIT-VI** | **Corrosion** | **Periods: 7** | |
| Corrosion –Introduction - factors – types – chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – electrochemical protection – sacrificial anode method and impressed current cathodic method. Uses of inhibitors, metallic coating – anodic coating, cathodic coating. Metal cladding, Electroplating of Copper and electroless plating of nickel. | | | **CO6** |

| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**


1. V Rajendran, “Engineering Physics”, TMH, New Delhi , 2nd Edition ,2011.
2. S.S Dara – “A text book of Engineering Chemistry” -. S.Chand Publications, 15th Edition, 2021
3. C.Jain, Monica Jain ”Engineering Chemistry”, Dhanpat Rai Pub. Co., New Delhi, 17th Edition (2015).


**Reference Books**


1. R.Murugeshan, “Modern Physics”, S. Chand &Co, New Delhi 2006.
2. William D Callister Jr., “Material Science and Engineering”, John Wiley and sons, 6th Edition, 2009.






3. Jain & Jain “Engineering chemistry”, DhanpatRai Publishing Company. 23rd Edition, 2022
4. Mars Fontana “Corrosion Engineering”, July 2017
5. JinaRedlin, “Handbook of Electrochemistry”, March 28, 2005

**Web References**

1. https://www.sciencedaily.com/terms/materials_science.htm.
2. https://www.acs.org/content/acs/en/careers/college-to-career/chemistry-careers/materials science.html.
3. https://study.com/academy/lesson/semiconductors-superconductors-definition-properties.html
4. https://mechanicalc.com/reference/engineering-materials
5. http://ndl.ethernet.edu.et/bitstream/123456789/89589/1/%5BPerez_N.%5D_Electrochemistry_and_corrosion%28BookZZ.org%29.pdf

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| 4 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | 3 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus





Dr. L. M. Varalakshmi

| Department | Civil / Mechanical | | | Programme: B.Tech. | | | |
|---|---|---|---|---|---|---|---|
| Semester | I / II | | | Course Category: ES | | *End Semester Exam Type: TE | |
| Course Code | U23ESTC01 | Periods/Week | | | Credit | Maximum Marks | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | Basics of Civil and Mechanical Engineering | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| (Common to ECE, EEE, ICE, MECH, CIVIL Branches) | | | | | | | | |
| Prerequisite | Basic Science | | | | | | | |

| Course Outcomes | On completion of the course, the students will be able to | BT Mapping (Highest Level) |
|---|---|---|
| CO1 | Understand the types of buildings and materials. | K2 |
| CO2 | Summarize on the various components of buildings and surveying concepts | K2 |
| CO3 | Identify the various infrastructure facilities | K2 |
| CO4 | To familiarize the working principles of IC engines and automobile systems | K2 |
| CO5 | To understand about the power generation systems and its components | K1 |
| CO6 | To acquire knowledge about the various machining process. | K2 |

**SECTION A - CIVIL ENGINEERING**

| UNIT - I | Buildings And Buildings Materials | Periods: 08 |
|---|---|---|
| Buildings – Definition – Classification according to NBC-plinth area, Floor area, carpet area, floor space index - Development of Smart cities - Green building, Benefits from green building. Building Materials - stone, brick, cement, cement mortar, concrete, steel, Timber - their properties and uses | | CO1 |
| **UNIT - II** | **Buildings Components and Surveying** | **Periods: 08** |
| Various Buildings Components and their functions. Foundation: function and types - Brick masonry, Stone Masonry and its types – Floors, Roofs and its types. Surveying: Objects – Classification – Principles – Measurements of Distances and areas –Leveling | | CO2 |
| **UNIT - III** | **Basic Infrastructure** | **Periods: 07** |
| Roads and Bridges – types, components advantage and disadvantages. Railways - Permanent way and its elements. Sources of Water - Quality of Water- Domestic sewage Treatment – Rain Water harvesting – Dams - site selection for dam construction, types of dams. | | CO3 |

**SECTION B – MECHANICAL ENGINEERING**

| UNIT- IV | Internal And External Combustion Systems | Periods: 08 |
|---|---|---|
| IC engines – Classification – Working principles – Diesel and Petrol Engines: Two stroke and four stroke engines – merits and demerits.<br>Steam generators (Boilers) – Classification – Constructional features (of only low-pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications. | | CO4 |
| **UNIT- V** | **Power Generation Systems, Refrigeration and Air Conditioning System** | **Periods: 07** |
| Power plants: Thermal – Nuclear, Hydraulic, Solar, Wind, Geothermal, Wave, Tidal and Ocean Thermal Energy Conversion systems - Functions, Applications - Schemes and layouts (Description only)<br>Refrigeration and Air Conditioning System: Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner. | | CO5 |
| **UNIT- VI** | **Manufacturing Process** | **Periods: 07** |
| Lathe - types, Specifications, Operations of a centre lathe. Casting - Pattern making, Allowances, Green sand and dry sand moulding, casting defects. Welding - Arc and Gas welding process, brazing and soldering (process description only). | | CO6 |

**Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45**

**Text Books**


1. Dr. S. Jayakumar, “Basic Civil Engineering”, Aagash Nekaa Publications, 2011
2. G Shanmugam, MS Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education, 1st Edition, 2018.
3. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.


**Reference Books**



Dr. L. M. Varalakshmi

1. M.P. Poonia, S.C. Sharma and T.R. Banga, Basic Mechanical Engineering, Khanna Publishing House 2018.
2. S.S.Bhavikatti, Basic Civil engineering, New Age International Ltd. 2018.
3. V. Rameshbabu, Basic Civil & Mechanical Engineering, VRB Publishers Private Limited, January 2017.
4. Serope Kalpakjian, Steven Schmid, Manufacturing Engineering and Technology, Pearson Publication, 7th Edition, 2014.
5. Gopi Satheesh, Basic Civil engineering, Pearson Publications, 3rd Edition, 2015.

**Web References**

1. https://nptel.ac.in/courses/112107291/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/ lecture-notes/
4. https://nptel.ac.in/courses/105102088/
5. https://nptel.ac.in/courses/105104101/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | - |
| 2 | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | - |
| 3 | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | - |
| 4 | 3 | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - | - |
| 5 | 3 | 1 | - | - | - | - | - | - | - | - | - | 1 | - | - | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. L. M. Varalakshmi

| Department | **Computer Science and Engineering** | Programme: **B.Tech** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **I** | Course Category: **ES** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23CSTC02** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Problem Solving Approach** | **3** | **-** | **-** | **3** | **25** | **75** | **100** |

(Common to CSE, ICE and CCE)

| Prerequisite | NIL | |
|---|---|---|
| **Course Outcomes** | **After completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Explain the basic concepts of computational thinking and problem solving. | **K2** |
| | **CO2** Explain basic concepts of algorithm and data organization. | **K2** |
| | **CO3** Illustrate algorithmic solution to problem solving. | **K3** |
| | **CO4** Explain the concepts of array, merging, sorting & searching. | **K2** |
| | **CO5** Implement recursive algorithm to solve problems. | **K3** |

| **UNIT-I** | **Computational Thinking and Logic-Solving Problems** | **Periods: 9** | |
|---|---|---|---|
| Computational Thinking – Information and Data – Converting Information into Data – Data Capacity – Data Types and Encoding – Logic-Solving Problems – Limits of Computation – Pseudocode and Flow Chart. | | | **CO1** |
| **UNIT-II** | **Algorithmic Thinking and Data Organization** | **Periods: 9** | |
| Algorithmic Thinking: Algorithms – Software and Programming Languages – Actions. Data Organization: Name list, Graph Hierarchies – Spread Sheets – Text processing – Patterns – Pseudocode and Flow Chart. | | | **CO2** |
| **UNIT-III** | **Fundamental Algorithms and Factoring Methods** | **Periods: 9** | |
| Fundamental Algorithms: Exchanging – Counting – Summing – Factorial Computation – Fibonacci Sequence – Reversing the Digit-Base Conversion – Character to number conversion. Factorial Methods: Finding Square Root – Greatest Common Divisor – Prime Number – Prime Factor – Pseudocode and Flow Chart. | | | **CO3** |
| **UNIT-IV** | **Array, Merging, Sorting and Searching** | **Periods: 9** | |
| Array Techniques: Introduction – Array order reversal – Array Counting or Histogramming – Maximum and Minimum of a Set – Removal of Duplicate – Partitioning – Longest monotone. Sorting and searching: Sorting by Bubble, Selection, Insertion. Searching: Linear, Binary – Pseudocode and Flow Chart. | | | **CO4** |
| **UNIT-V** | **Text Processing, Pattern Searching and Recurcive Algorithms** | **Periods: 9** | |
| Key word Searching – Text Line Adjustment – Linear Pattern Search – Sub Linear Pattern Search. Recursion: Towers of Hanoi – Sample Generation – Combination Generation – Permutation Generation – Pseudocode and Flow Chart. | | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. David Riley and Kenny Hunt, “Computational Thinking for Modern Problem Solver”, Chapman & Hall/CRC Textbooks in Computing, 2014.
2. R.G.Dromey, “How to solve it by Computer”,PHI,2008.
3. Vickers Paul, “How to Think like a Programmer: Problem Solving for the Bewildered”, Cengage Learning EMEA,2008.

**Reference Books**

1. Kathryn Rentz, Paula Lentz, “A Problem-solving Approach”, McGraw-Hill Education,2018.
2. Don McAdam, Roger Winn, “A Problem-solving Approach”, Prentive Hall Canada; 2nd Edition, 2017.
3. V Anton Spraul, “Think Like a Programmer: An Introduction to Creative Problem Solving”, Cengage Learning EMEA, 2012.
4. Sham Tickoo “A Problem-solving Approach”, Delmar/Cengage Learning, 2009.
5. Harold Abelson & Gerald Jay Sussman, “Structure and Interpretation of Computer Programs”, McGraw-Hill Book Company, 1997.

**Web References**

1. https://www.edx.org/learn/problem-solving
2. https://www.lynda.com/Business-Skills-tutorials/Problem-Solving-Techniques/553700-2.html
3. https://www.classcentral.com/course/problem-solving-skills-6687

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 1 | - | - | 1 | - | - | - | 1 | - | - | 1 | 3 | 2 | 3 |
| 2 | 2 | 1 | - | - | 1 | - | - | - | - | - | - | 1 | 3 | 2 | 3 |
| 3 | 2 | 1 | - | - | 1 | - | - | - | - | - | - | 1 | 3 | 2 | 3 |
| 4 | 2 | 1 | - | - | 1 | | - | - | - | - | - | 1 | 3 | 2 | 3 |
| 5 | 3 | 2 | 1 | 1 | 1 | - | - | - | - | - | - | 1 | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 10 | | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **I** | Course Category: **PC** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT101** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Fundamentals of Electrical Machines** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to all Branches)

| Prerequisite | Physics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Gain Knowledge about the basic concepts of magnetic circuits. | **K2** |
| | **CO2** Describe the working of transformer, auto transformer and assess the regulation and efficiency of transformer. | **K2** |
| | **CO3** Demonstrate the operation of DC machines and their performance characteristics. | **K3** |
| | **CO4** Explain the working concept of single phase, three phase induction motor and analyze the operating behavior of induction motor | **K3** |
| | **CO5** Understand the working concepts of special machines | **K3** |

| **UNIT-I** | **Magnetic Circuits (Qualitative Treatment Only)** | **Periods: 09** | |
|---|---|---|---|
| Definition of MMF, Flux and Reluctance - Leakage Factor - Reluctances in Series and Parallel (Series and Parallel Magnetic Circuits) - Electromagnetic Induction - Fleming's Rule - Lenz's Law - Faraday's laws - statically and dynamically induced EMF - Self and mutual inductance - Analogy of Electric and Magnetic Circuits. | | | **CO1** |
| **UNIT-II** | **Transformers (Qualitative Treatment Only)** | **Periods: 09** | |
| Construction and Principle of operation of Single Phase Transformer - EMF Equation - Phasor Diagram on No Load and Loaded Transformer -Equivalent Circuit - Regulation and Efficiency. Introduction to auto transformers. | | | **CO2** |
| **UNIT-III** | **D.C Machines (Qualitative Analysis Only)** | **Periods: 09** | |
| Construction, Principles of operation of DC Generators - Types –EMF Equation - Performance Characteristics of Series and Shunt Generators.<br>DC Motor - Torque Equation- Speed - Torque Characteristics of Series and Shunt Motors – Speed Control methods and Applications. Need for starter – types. | | | **CO3** |
| **UNIT-IV** | **Induction Motors (Qualitative Treatment Only)** | **Periods: 09** | |
| Constructional Details of Three Phase Induction Motor - Slip Ring and Squirrel Cage Rotor- Principle of operation- Torque Equation - Torque / Slip Characteristics - Starters - Applications Introduction to Single Phase Induction Motors - Capacitor Start Capacitor Run Motor -Shaded Pole Motor. | | | **CO4** |
| **UNIT-V** | **Synchronous Machines And Special Machines (Qualitative Treatment Only)** | **Periods: 09** | |
| Principles of Alternator - Construction Details - Types Special Machines: Stepper motor- AC and DC Servomotor - Permanent Magnet Synchronous Motor - Brushless D.C Motor - Construction, Working and Applications. | | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**


1. J.B. Gupta, "Theory and Performance of Electrical Machines", S.K. Kataria & Sons, 4th Edition, 2013.
2. B.L. Theraja and A.K. Theraja, "A Text Book of Electrical Technology, Vol. II", S. Chand & Company Ltd., 2010.
3. R.K. Rajput, "Electrical Engineering" Lakshmi Publications Pvt Limited, 4th Edition, 2018.


**Reference Books**


1. S.K. Bhattacharya, "Electrical Machines", Tata Mc Graw Hill Company Ltd, 4th Edition, 2014.
2. D P Kothari and I.J Nagarath, "Electrical Machines", McGraw Hill Education(India) Private Limited, Fifth edition, 2019.
3. Nagsarkar, T. K., Sukhija, M. S. Principles of Basic Electrical Engineering. Canada: Oxford University Press, 2018.
4. Edward Hughes "Electrical and Electronic Technology", Pearson Education, 10th Edition, 2011.
5. Abhijit Chakrabarti and Sudipta Debnath, "Electrical Machines", McGraw- Hill Education, 2015
6. Janardanan, E. Special Electrical Machines. India: PHI Learning, 2014


**Web References**

1. https://www.electricaltechnology.org/
2. https://nptel.ac.in/courses/108105053/
3. https://www.youtube.com/watch?v=FAjM4C7dssM

* TE – Theory Exam, LE – Lab Exam



Dr. L. M. Varalakshmi

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 | 2 |
| 2 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 | 2 |
| 3 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 | 2 |
| 4 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 | 2 |
| 5 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 | 2 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 10 | | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **English** | Programme: **B.Tech.** | | | | | | |
| Semester | **First** | Course Category : HS | | | End Semester Exam Type:**TE** | | | |
| Course Code | U23ENBC01 | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Communicative English - I** | **2** | **-** | **2** | **3** | **50** | **50** | **100** |

**(Common to ALL Branches except CSBS)**

| | | | |
|---|---|---|---|
| Prerequisite | Basics of English Language | | |
| Course Outcomes | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Understand the communication flow in organization and its objectives | **K2** |
| | **CO2** | Write the technical contents with grammatically precise sentences | **K2** |
| | **CO3** | Articulate with correct pronunciation and overcome vernacular impact in speaking | **K3** |
| | **CO4** | Express opinions confidently in formal and informal communicative contexts | **K2** |
| | **CO5** | Attend interview with assertiveness | **K3** |

| | | | |
|---|---|---|---|
| **UNIT- I** | **Workstead Communication** | **Periods:10** | |
| Communication, Definition, Process, Channels, Barriers, Strategies for Effective Communication, Verbal and Nonverbal Communication - Listening, Types, Barriers, Enhancing Listening Skills - Bibliography: Book, Journal and Internet References | | | **CO1** |
| **UNIT- II** | **Common Errors In Writing And Comprehension Strategies** | **Periods:10** | |
| Subject Verb Agreement, Misplaced Modifiers, Squinting Modifiers, Dangling Modifier, Fused Sentence, Comma Splice, Sentence Fragment - Reading Comprehension: Technical passage, Strategies: Skimming, Scanning, Intensive and Extensive Reading, Prediction, and Contextual Meaning | | | **CO2** |
| **UNIT- III** | **Phonetics** | **Periods:10** | |
| Pronunciation Guidelines to consonants and vowels, Sounds Mispronounced, Silent and Non-silent Letters, Intonation, Spelling Rules and Words often misspelled, Mother Tongue Influence (MTI), Various Techniques for Neutralization of Mother Tongue | | | **CO3** |
| **UNIT- IV** | **Communication Practice-I** | **Periods:15** | |
| **List of Exercises**<br>**Listening**: Self Introduction videos<br>**Speaking**: Self-Introduction, Extempore, and Role Play<br>**Reading**: Non-Technical Comprehension Passage<br>**Writing:** Common Errors in Writing | | | **CO4** |
| **UNIT-V** | **Interpersonal Communication-I** | **Periods:15** | |
| **List of Exercises**<br>**Listening:** Speech Sounds, Interview Videos<br>**Speaking**: Debate, Structured Group Discussion, and Conversation<br>**Reading**: Commonly Confused Words<br>**Writing:** Transcription | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:30** | **Tutorial Periods:-** | **Practical Periods:30** | **Total Periods:60** |

**Text Books**

1. Richa Mishra , RatnaRao, “A textbook of English Language Communication Skills”, Macmillan Publishers India Private Ltd., Revised Edition 2021.
2. Rizvi M. Ashraf, “Effective Technical Communication”, New Delhi: Tata-McGraw-Hill Publishing Company Limited, 4th Edition, 2010.
3. Balasubramanian T, “English Phonetics for Indian students workbook”, 2nd Edition, Trinity Press, 2016.

**Reference Books**

1. N.P.Sudharshana, C. Savitha,” English for Engineers”, Cambridge University Press, 2018.
2. Raman, Meenakshi, and Sharma, Sangeetha, “Technical Communication - Principles and Practice”, 3rd Edition, Oxford University Press, 2017.
3. Comfort, Jeremy,etal., “Speaking Effectively: Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge, Reprint 2011.
4. Wren & Martin, “High School English Grammar and Composition”, S Chandh &Co. Ltd, 2015.
5. Boove, Courtland L, “Business Communication Today”, Pearson Education, New Delhi,2002.

**Web References**

1. https://lemongrad.com/subject-verb-agreement-rules/
2. https://opentextbc.ca/advancedenglish/chapter/misplaced-and-dangling-modifiers/
3. https://www.hitbullseye.com/Reading-Comprehension-Tricks.php

4. https://www.softwaretestinghelp.com/how-to-crack-the-gd/
5. https://worldscholarshipvault.com/neutralize-mother-tongue-interference/

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 2 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 3 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 4 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 5 | 1 | - | - | - | - | - | - | - | 1 | 3 | - | 1 | - | - | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Theory | | | | | | |
|---|---|---|---|---|---|---|
| Assessment | Continuous Assessment Marks (CAM) | | | | End Semester Examination (ESE) Marks | Total Marks |
| | CAT 1 | CAT 2 | Model Exam | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 75 | 60 |
| | 20( to be weighted for 10 marks) | | | | (to be weighted for 50 marks) | |

| Practical | | | | |
|---|---|---|---|---|
| Continuous Assessment Internal Evaluation | | End Semester Internal Evaluation | | Total Marks |
| 30(to be weighted for 10 marks) | | 30 marks | | 40 |
| Listening (L)* | 10 | Listening (L)* | 10 | |
| Speaking(S) | 5 | Speaking(S) | 5 | |
| Reading(R)* | 10 | Reading(R)* | 10 | |
| Writing(W)* | 5 | Writing(W)* | 5 | |

- **LRW components of Practical can be evaluated through Language Lab Software**

| Department | **Mechanical Engineering** | | | Programme: **B.Tech.** | | | |
|---|---|---|---|---|---|---|---|
| Semester | **I / II** | | | Course Category : **ES** | | End Semester Exam Type: **LE** | |
| Course Code | **U23ESPC02** | Periods/Week | | | Credit | Maximum Marks | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Design Thinking and IDEA Lab** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| (Common to ALL Branches) | | | | | | | | |
| Prerequisite | Basic Knowledge of Science | | | | | | | |

| | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
|---|---|---|---|
| **Course Outcomes** | **CO1** | Demonstrate a comprehensive understanding of the tools and inventory associated with the IDEA Lab. | **K2** |
| | **CO2** | Develop proficiency in ideation techniques to generate creative and innovative solutions for various design challenges and problems | **K3** |
| | **CO3** | Acquire practical knowledge of mechanical and electronic fabrication processes, including hands-on experience with machinery, tools, and techniques used in the manufacturing and assembly of physical components. | **K3** |
| | **CO4** | Cultivate the skills necessary for developing innovative and desirable products, including the ability to integrate user needs, market trends, and technological advancements into the design process. | **K4** |
| | **CO5** | Apply iterative design methodologies to refine and improve solutions based on feedback, user testing, and evaluation of functional, aesthetic, and usability aspects | **K4** |

**Design process:** Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design, Innovative design: Breaking of patterns, Reframe existing design problems, Principles ofcreativity Empathy: Customer Needs, Insight-leaving from the lives of others/standing on the shoes of others, Observation

**Design team-Team formation, Conceptualization:** Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, Wooden model, Clay model, 3D printing; Experimenting/testing.

Sustainable product design, Ergonomics, Semantics, Entrepreneurship/business ideas, Product Data Specification, establishing target specifications, Setting the final specifications. Design projects for teams.

**List of Lab Activities and Experiments**

1. Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
2. Machining of 3D geometry on soft material such as softwood or modelling wax.
3. 3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
4. 2D profile cutting of press fit box/casing in acrylic (3 or 6 mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6. Familiarity and use of welding equipment.
7. Familiarity and use of normal and wood lathe.
8. Embedded programming using Arduino and/or Raspberry Pi.
9. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.
10. Discussion and implementation of a mini project.
11. Documentation of the mini project (Report and video).

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Text Books**


1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd
2. Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing.


**Reference Books**


1. Ulrich and Eppinger, Product Design and Development, McGraw Hill, 3rd Edition, 2004
2. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018.
3. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan, Weldon Owen; 2017.

4. . Paul Horowitz and Winfield Hill " The Art of Electronics" Cambridge University Press. 3rd edition.
5. Paul Sherz and Simon Monk "Practical Electronics for Inventors". .. McGraw Hill. 4th edition
6. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education.
7. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill.
8. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer
9. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and Distributors, 5th Edition,2002.

**Web References**

1. https://onlinecourses.nptel.ac.in/noc23_mg72

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | 2 | - | 3 | 2 | - | - | - |
| 2 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | 2 | - | 3 | 2 | - | - | - |
| 3 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | - | 3 | 2 | - | - | - |
| 4 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | - | 3 | 2 | - | - | - |
| 5 | 3 | 3 | 3 | 2 | 3 | 2 | - | - | 2 | - | 3 | 2 | - | - | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |



Dr. L. M. Varalakshmi

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **I** | Course Category: **ES** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP101** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Problem Solving Approach Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to all Branches)

| Prerequisite | Basics of Mathematics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** To understand and apply algorithmic thinking. | **K2** |
| | **CO2** To demonstrate proficiency in flowcharting. | **K2** |
| | **CO3** To implement a programming solution and apply mathematical concepts. | **K3** |
| | **CO4** To develop problem-solving skills. | **K3** |
| | **CO5** To enhance debugging and error handling. | **K3** |

**List of Experiments**

1. Write an algorithm, Flowchart, pseudo code and program to find the sum of two numbers
2. Write an algorithm, Flowchart, pseudo code and program to find the average of three numbers
3. Write an algorithm, Flowchart, pseudo code and program to find an odd number between 1 to 50.
4. Write an algorithm, Flowchart, pseudo code and program to find even numbers between 1 to 50.
5. Write an algorithm, Flowchart, pseudo code and program to swap two numbers with and without a temporary variable.
6. Write an algorithm, Flowchart, pseudo code and a program to convert temperature from Celsius to Fahrenheit and vice versa.
7. Write an algorithm, Flowchart, pseudo code and program to find the Area and Perimeter of a Square and Circle.
8. Write an algorithm, Flowchart, pseudo code and program to find Simple Interest and compound interest.
9. Write an algorithm, Flowchart, pseudo code and program to find the roots of a quadratic equation.
10. Write an algorithm, Flowchart, pseudo code and program to check if the given year is leap year or not
11. Write an algorithm, Flowchart, pseudo code and program to check if the given number is Armstrong or not.
12. Write an algorithm, Flowchart, pseudo code and program to generate the first n terms of the Fibonacci sequence.

| **Lecture Periods:** | **Tutorial Periods:-** | **Practical Periods: 45** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**


1. David Riley and Kenny Hunt, “Computational Thinking for Modern Problem Solver”, Chapman & Hall/CRC Textbooks in Computing, 2014.
2. R.G. Dromey, “How to solve it by Computer”,PHI,2008.
3. Vickers Paul, “How to Think like a Programmer: Problem Solving for the Bewildered”, Cengage Learning EMEA, 2008.


**Reference Books**


1. Kathryn Rentz, Paula Lentz, “A Problem-solving Approach”, McGraw-Hill Education,2018.
2. Don Mc Adam, Roger Winn, “A Problem-solving Approach”, Prentive Hall Canada; 2nd Edition, 2017.
3. V Anton Spraul, “Think Like a Programmer: An Introduction to Creative Problem Solving”, Cengage Learning EMEA, 2012.
4. Sham Tickoo “A Problem-solving Approach”, Delmar/Cengage Learning, 2009.
5. Harold Abelson & Gerald Jay Sussman, “Structure and Interpretation of Computer Programs”, McGraw-Hill Book Company, 1997.


**Web References**

1. Geeks for Geeks (www.geeksforgeeks.org)
2. Stack Overflow (stackoverflow.com)
3. W3Schools (www.w3schools.com)

* TE – Theory Exam, LE – Lab Exam



Dr. L. M. Varalakshmi

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | 2 | 3 | - | - | - | - | - | - | 2 | - | 2 | 1 |
| 2 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 2 | - | 2 | 1 |
| 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 2 | - | 2 | 1 |
| 4 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 2 | - | 2 | 1 |
| 5 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | 2 | - | 2 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **I** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP102** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Fundamentals of Electrical Machines Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| (Common to all Branches) | | | | | | | | |
| Prerequisite | | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Acquire knowledge on wiring electrical circuits such as domestic and Go-Down wiring. | **K2** |
| | **CO2** Apply appropriate measurement techniques for the calculation of power and performance of machines. | **K2** |
| | **CO3** Estimate the performance of DC and induction motor by conducting load and no-load tests. | **K3** |
| | **CO4** Acquire hands on experience of conducting speed tests on DC machines and obtaining their characteristic curve using standard analytical as well as graphical methods | **K3** |
| | **CO5** Acquire hands on experience of conducting various tests on alternators. | **K3** |

**List of Experiments**

1. Wiring circuits for
   A. Go Down wiring
   B. Staircase
   C. Ceiling fan and fluorescent lamp wiring
2. Load test on single phase transformer
3. Open circuit and short circuit test on single phase transformer
4. Load characteristics of dc shunt motor
5. Speed control of dc shunt motor.
6. Load characteristics of dc series motor
7. Open circuit characteristics of separately excited dc shunt generator
8. Load test on single phase Induction motor
9. Load test on single phase Alternator
10. Study of DC and AC starters

| **Lecture Periods:** | **Tutorial Periods:-** | **Practical Periods: 45** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. J.B. Gupta, “Theory and Performance of Electrical Machines”, S.K. Kataria & Sons, 4th Edition, 2013.
2. B.L. Theraja and A.K. Theraja, “A Text Book of Electrical Technology, Vol.II”, S. Chand & Company Ltd., 2010.
3. R.K. Rajput, “Electrical Engineering” Lakshmi Publications Pvt Limited, 4th Edition, 2018.

**Reference Books**

1. Umesh Agarwal, “Laboratory Manual Basic Electrical Engineering, 2019”, Notion Press, 1st Edition, 2019.
2. P. Tiwari & S. Sairola S.K. Kataria & Sons, “Electrical Engineering Laboratory Practice ",Reprint 2010 Edition 2010.
3. Kothari, D. P., Umre, B. S. Laboratory Manual for Electrical Machines. India: I.K. International Publishing House Pvt. Limited, 2016
4. Chaturvedi, D. K. (2010). Electrical Machines Lab Manual with MATLAB Programs. India: Laxmi Publications Pvt Limited.
5. Janardanan, E. Special Electrical Machines. India: PHI Learning, 2014.

**Web References**

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://nptel.ac.in/courses/108/105/108105017/
3. http://www.cittumkur.org/eee/em.pdf

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | 2 | - | | - | | | - | | | 3 | 2 | 2 |
| 2 | 3 | 2 | 3 | 1 | 1 | | - | | | - | | | 3 | 2 | 2 |
| 3 | 3 | 2 | 3 | 1 | 1 | | - | | | - | | | 3 | 2 | 2 |
| 4 | 3 | 2 | 3 | 1 | 1 | | - | | | - | | | 3 | 2 | 2 |
| 5 | 3 | 2 | 3 | 1 | 1 | | - | | | - | | | 3 | 2 | 2 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

## Evaluation Method

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| U23ICC1XX | CERTIFICATION COURSE - I | L | T | P | C | Hrs |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 4 | - | 50 |

Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | Total Marks |
|---|---|---|---|
| | Attendance | MCQ Test | |
| Marks | 10 | 90 | 100 |



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| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **I** | Course Category: **MC** | | | End Semester Exam Type: - | | | |
| Course Code | **U23ICM101** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Induction Programme** | **2 weeks** | | | Non-Credit | - | - | - |
| **Prerequisite** | **-** | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Develop holistic attitude and harmony in the individual, family, and Society | **K2** |
| | **CO2** Acquire grammar skills and capable to write and speak English confidently | **K2** |
| | **CO3** Understand the basic concepts in Mathematics and Programming | **K2** |
| | **CO4** Know about the art and culture, language and literature of this vast secular nation | **K2** |
| | **CO5** Identify the inherent talent and develop it professionally | **K3** |

| **UNIT-I** | **Universal Human Values** | **Periods: 12** | |
|---|---|---|---|
| Welcome and Introductions - Getting to know each other, Aspirations and Concerns - Individual Academic and Career Expectations of Family, Peers, Society, Nation, Fixing one's Goals, Self-Management - Self-confidence, Peer Pressure, Time Management, Anger, Stress Personality Development, Self-improvement, Health - Health issues, Healthy diet, Healthy lifestyle, Hostel life, Relationships - Home sickness, Gratitude towards Parents, Teachers and others Ragging and interaction, Competition and Cooperation, Peer Pressure, Society - Participation in Society, Natural Environment - Participation in Nature, Sum Up - Role of Education, Need for a Holistic Perspective, Self-evaluation and Closure - Sharing and feedback. | | | **CO1** |
| **UNIT-II** | **Proficiency in English** | **Periods: 12** | |
| Communication skills - Prognostic test on Grammar - Synonyms, Antonyms, Tenses, Sentence Completion, Idioms and Phrases, One- word Substitution, Homophones, Homonyms, Use of Prepositions, Subject-verb Agreement - Writing - Paragraph writing, Letter writing, Essay writing, Story Development. | | | **CO2** |
| **UNIT-III** | **Bridge Course in Mathematics and C Programming** | **Periods: 12** | |
| **Mathematics:**<br>Fundamentals of differential and integral calculus: Theory and Practice, Limit of function - Fundamental results on limits - Continuity of a function - Concept of differentiation - Concept of derivative - Slope of a curve -Differentiation Techniques - Derivatives of elementary functions from first principle - Derivatives of inverse functions - Logarithmic differentiation - Method of substitution - Differentiation of parametric functions -Differentiation of implicit functions - Higher order derivatives. Integrals of functions containing linear functions -Method of integration (Decomposition method, method of substitution, integration by parts) - Definite integrals. Simple definite integrals - Properties of Definite integrals - Reduction formulae - Area and volume - Length of curve - surface area of a solid.<br>**C Programming:**<br>Features of C and its basic Structure - Keywords - constants - variables - operators - Data types - Formatted input and output statements - Control and Looping statement - Arrays - Functions - Strings - writing simple C programs. | | | **CO3** |
| **UNIT-IV** | **Literary Activities** | **Periods: 12** | |
| Team building activities - Quiz - Oral Exercises - Group discussion, Debate, Extempore, Role play, - . | | | **CO4** |
| **UNIT-V** | **Creative Arts** | **Periods: 12** | |
| Introduction to painting and renowned artworks - Documentary and Short films - Music - Vocal, Instrumental - Dance - Classical, Cinematic - Mimicry - Mime. | | | **CO5** |

| **Lecture Periods: 60** | **Tutorial Periods: -** | **Practical Periods: -** | **Lecture Periods: 60** |
|---|---|---|---|

**Reference Books**


1. R.R Gaur, R. Asthana, G.P. Bagaria," A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, 2nd Revised Edition, 2019.
2. Kumar Mohan R, "English Grammar for all (Functional and Applied Grammar)", Unicare Academy, 2022.
3. Seely, John," Oxford A-Z of Grammar and Punctuation, Oxford Publication, 2013.
4. B.V. Ramana," Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
5. Dr. A. Singaravelu, "Engineering Mathematics - I", Meenakshi publications, Tamil Nadu, 2019.
6. E. Balagurusamy, "PROGRAMMING IN ANSI C", Mc Graw Hill, 8th Edition, 2019.
7. Dr.K.K.Pillay,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL
8. R.Balakrishnan, "Journey of Civilization",Roja muthiah research publishers, 1st Edition 2019


**Web References**



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1. http://www.newsociety.com/Books/S/Slow-isBeautiful
2. https://www.aplustopper.com/formal-letter/
3. https://www.javatpoint.com/c-programming-language-tutorial
4. http://www.math.cum.edu/~wn0g/2ch6a.pdf
5. https://education.nsw.gov.au/teaching-and-learning/curriculum/creative-arts

**Evaluation methods**

| Assessment | Continuous Assessment Marks (CAM) | | | Total Marks |
|---|---|---|---|---|
| | Attendance | MCQ Test | Presentation / Activity / Assignment | |
| **Marks** | 10 | 30 | 60 | 100 |

| Department | **Mathematics** | Programme : **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category: **BS** | | | End Semester Exam Type: TE | | | |
| Course Code | **U23MATC02** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Engineering Mathematics – II** | **3** | **1** | **0** | **4** | **25** | **75** | **100** |

(Common to ALL Branches Except CSBS, FT)

| Prerequisite | Basic Mathematics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Convert a periodic function into series form. | **K2** |
| | **CO2** Compute Fourier transforms of various functions. | **K3** |
| | **CO3** Solve Differential Equations using Laplace transforms. | **K3** |
| | **CO4** Apply inverse Laplace transform of simple functions. | **K3** |
| | **CO5** Solve difference equations using Z – transforms. | **K3** |

| **UNIT – I** | **Fourier Series** | **Periods:12** | |
|---|---|---|---|
| Dirichlet's conditions – General Fourier series – Odd and Even functions – Half-Range sine series and cosine series – Change of intervals – Parseval's Identity. | | | **CO1** |

| **UNIT – II** | **Fourier Transforms** | **Periods:12** | |
|---|---|---|---|
| Fourier Transforms and its inverse – Properties of Fourier Transform (without proof) – Fourier sine and cosine Transforms and their properties (excluding proof). | | | **CO2** |

| **UNIT – III** | **Laplace Transforms** | **Periods:12** | |
|---|---|---|---|
| Laplace transforms of elementary functions and Periodic functions – Basic properties (excluding proof) – Laplace transforms of derivatives and integrals – Initial and final value theorems. | | | **CO3** |

| **UNIT – IV** | **Inverse Laplace Transforms** | **Periods:12** | |
|---|---|---|---|
| Definition of inverse Laplace Transforms – Convolution theorem (excluding proof) – Solutions of Linear Ordinary Differential Equations of second order with constant coefficients. | | | **CO4** |

| **UNIT – V** | **Z – Transforms** | **Periods:12** | |
|---|---|---|---|
| Z-transforms – Elementary Properties – Inverse Z-transforms (using partial fraction and Residues) – Solution of difference equations using Z - transform. | | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods: 15** | **Practical Periods: -** | **Total Periods: 60** |
|---|---|---|---|

**Text Books**


1. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2. C. P. Gupta, Shree Ram Singh. M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2nd Edition, 2016.
3. H.K. Dass, "Advanced Engineering Mathematics", S. Chand, New Delhi, 22nd Edition 2019.


**Reference Books**


1. N.P. Bali and Dr. Manish Goyal, "A TEXTBOOK OF ENGINEERING MATHEMATICS", UNIVERSITY SCIENCE PRESS, India, 8th Edition, 2016.
2. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearson India Education services Pvt. Ltd, India 1st 2017.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019.
4. G. Balaji, "Engineering Mathematics - Transforms and Partial Differential Equations", G. Balaji Publishers, 18th Edition, 2022.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2017.


**Web References**

1. https://nptel.ac.in/courses/111105121/
2. https://nptel.ac.in/courses/111105035/
3. https://nptel.ac.in/courses/11110711
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. https://nptel.ac.in/courses/111/103/111103021/

* TE – Theory Exam, LE – Lab Exam



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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 2 | - | - | 1 | - | - | - | - | - | 1 | 1 | - | - |
| **2** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | 1 | 3 | - | - |
| **3** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | 1 | 3 | - | - |
| **4** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | 1 | 3 | - | - |
| **5** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | 1 | 3 | - | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Computer Science and Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **II** | Course Category: **ES** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23CSTC01** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Programming in C** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to All Branches)

Prerequisite: -

| Course Outcome | On completion of the course, the students will be able to | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Comprehend the basics of Computers. | **K2** |
| **CO2** | Illustrate the concepts of control structures and looping. | **K2** |
| **CO3** | Implement programs using arrays and functions. | **K3** |
| **CO4** | Demonstrate programs using Structure and Pointers. | **K3** |
| **CO5** | Build the programs using Union and File management Operations. | **K3** |

| | | |
|---|---|---|
| **UNIT-I** | **Introduction** | **Periods: 09** |
| Generation and Classification of Computers - Block Diagram of a Computer –Categories of Software – Network Structure - Number System – Binary – Decimal – Conversion – Algorithm – Pseudo code – Flow Chart. | | **CO1** |
| **UNIT-II** | **C Programming Basics** | **Periods: 09** |
| Introduction to ' C' Programming – Basic structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements. | | **CO2** |
| **UNIT-III** | **Arrays And Functions** | **Periods: 09** |
| Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations- Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion | | **CO3** |
| **UNIT-IV** | **Structure And Pointers** | **Periods: 09** |
| Structure Introduction – Structure definition – Structure declaration – Structure within a structure –Self Referential Structure. Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays -Pointer to Function –Pointer and Structure- Simple programs. | | **CO4** |
| **UNIT-V** | **Unions And Files** | **Periods: 09** |
| Union Introduction - Programs Using Structures and Unions – Introduction to File - File Operations - File Input and Output Functions - Random Access to Files - File System Functions - Command Line Arguments- Storage Classes - Pre-Processor Directives- Dynamic Memory Functions. | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods: 45** | **Tutorial Periods:** | **Practical Periods: -** | **Total Periods: 45** |

**Text Books**


1. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, 8thEdition,2019.
2. YashvantKanetkar, "Let us C", BPB Publications, 16th Edition, 2017
3. Herbert Schildt," C: The Complete Reference", McGraw Hill, FourthEdition,2014


**Reference Books**


1. Vikas B. Agarwal Jyoti P. Mirani, "Computer Fundamentals , Nirali Prakashan Aug-2019,
2. Ashok N Kamthane, "Computer Programming", Pearson education, 2nd Impression,2012.
3. VikasVerma, "A Workbook on C ", Cengage Learning, 2nd Edition,2012.
4. P.Visu, R.Srinivasan and S.Koteeswaran, "Fundamentals of Computing and Programming", Sri Krishna Publications, 4th Edition, 2012.
5. PradipDev, ManasGhoush, "Programming in C", Oxford University Press, 2nd Edition, 2011.


**Web References**

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-language-set-1-introduction/
3. https://www.tutorialspoint.com/cprogramming
4. https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c
5. https://nptel.ac.in/courses/106/104/106104128/

* TE – Theory Exam, LE – Lab Exam



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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 2 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 3 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 4 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 5 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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| Department | **Biomedical Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category: **PC** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23BMTC01** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Electron Devices and Circuits** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to BME and ICE Branches)

| Prerequisite | **Physics** | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Explains the operation of basic semiconductor diodes and its applications | **K2** |
| | **CO2** Classify the transistors configuration and analyze its characteristics | **K3** |
| | **CO3** Distinguish the special semiconductor devices and its applications | **K3** |
| | **CO4** Analyze the transistor using small signal model and understand the operation of different categories of amplifiers | **K4** |
| | **CO5** Investigate the operation of different types of feedback amplifiers and oscillators | **K3** |

| **UNIT-I** | **Diodes and their Applications** | **Periods: 9** |
|---|---|---|
| Formation of P-N junction diode- forward and reverse biased P-N junction, V-I characteristics, diffusion and transient capacitance, Zener diode and its reverse characteristics, Zener breakdown, Avalanche breakdown, Rectifiers-half wave rectifier, full wave rectifier with and without filters, Clippers, Clampers, Voltage Regulator – Zener diode as Voltage regulator. | | **CO1** |
| **UNIT-II** | **Bipolar Junction Transistor and Field Effect Transistor** | **Periods:9** |
| **Bipolar Junction Transistor:** Principle of operation –Current components, CE, CB, and CC Configurations, Input and output characteristics – Cut-off, active and saturation region, Transistor as a switch, Transistor as an amplifier. **Field Effect Transistor:** Classification - JFET and its characteristics – JFET parameters, MOSFET – principle of operation- Depletion and enhancement modes. | | **CO2** |
| **UNIT-III** | **Special Semiconductor Devices** | **Periods: 9** |
| Unijunction Transistor (UJT), Tunnel diode, Varactor diode, Schottky diode, Gunn diode, Light Emitting Diode (LED), Laser, PIN diode, Photo diode, Liquid Crystal Display (LCD), Silicon Control Rectifier (SCR), DIAC, TRIAC, Applications of SCR, DIAC, TRIAC. | | **CO3** |
| **UNIT-IV** | **Amplifiers** | **Periods: 9** |
| BJT small signal low frequency model using h parameter – Analysis of CE, CB and CC amplifiers, RC coupled amplifiers, Cascade amplifier, Power amplifiers –Class A, Class B, Class AB, Push Pull, Class C amplifiers. | | **CO4** |
| **UNIT-V** | **Feedback Amplifiers and Oscillators** | **Periods: 9** |
| Feedback amplifiers-Properties of negative feedback-voltage and current, Series and Shunt feedback, Positive feedback, Barkhausen Condition for oscillations, Classification of Oscillators, RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators. | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**


1. S.Salivahanan, N. Suresh Kumar, A. Vallavaraj, "Electronic Devices and Circuits", Tata Mcgraw-Hill, 2nd Edition, 2017
2. Jacob Millman,Chritos C Halkias," Electronic Devices and Circuits", McGraw Hill, 4th edition, 2015
3. R S Sedha "A Textbook of Applied Electronics" S.Chand Publications, 2008


**Reference Books**


1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits Theory, Pearson, 9th Edition, 2013.
2. Thomas L. Floyd, "Electronic devices" Prentice Hall", 10th Edition, 2018
3. Kumar and Jain, "Electronic devices and Circuits" PHI learning, 2016
4. Bakshi, U. A., & Godse, A. P.,"Electronic Devices and Circuits", Technical Publications,2008
5. Anil Kumar Maini., Varsha Agrawal, "Electronic devices and circuits", Wiley, 2019


**Web References**

1. https://nptel.ac.in/courses/117/103/117103063/
2. https://nptel.ac.in/courses/108108122/
3. https://www.electronics-tutorials.ws/

Department of Instrumentation and Control Engineering

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* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | - | 2 | 2 | - | - | - | - | - | - | 3 | - | 2 |
| 2 | 3 | 2 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 3 | - | 2 |
| 3 | 3 | 2 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 3 | - | 2 |
| 4 | 3 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 3 | - | 2 |
| 5 | 3 | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | 3 | - | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus





Dr. L. M. Varalakshmi

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category: **PC** | | | *End Semester Exam Type: **TE** | | |
| Course Code | **U23ICT202** | Periods / Week | | | Credit | Maximum Marks | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Transducer Engineering** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | Basics of Electronics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Comprehend the basic concepts of measurement systems and sensors | **K2** |
| | **CO2** Analyze the resistive transducers and apply them for various applications | **K2** |
| | **CO3** Gain knowledge on the types of inductive transducers and apply them for various applications | **K2** |
| | **CO4** Classify and apply various types of capacitive transducers and analyze various types of sensors | **K2** |
| | **CO5** Gain knowledge on Smart Sensors | **K3** |

| **UNIT-I** | **Measurements and Instrumentation of Transducers** | **Periods: 09** | |
|---|---|---|---|
| Functional blocks of a Measurement system. Fundamental and Derived units –Standards of Measurement. Classification of Errors: Error analysis, Statistical methods, Classification of transducers – Selection of transducers. | | | **CO1** |
| **UNIT-II** | **Variable Resistance Transducers** | **Periods: 09** | |
| **Resistive Transducers**: Resistance Potentiometer: Loading effect on Potentiometer. Resistance Strain gauges: Un bonded and Bonded type strain gauges.<br>**Applications:**<br>Temperature Measurement using RTD and Thermistor – Gas flow measurement using hot-wire Anemometer –measurement of moisture in solids and wood – level measurement using resistive tapes. | | | **CO2** |
| **UNIT-III** | **Variable Inductance Transducers** | **Periods: 09** | |
| **Inductive Transducers**: Simple inductance and Mutual inductance Transducers – Induction Potentiometers. Linear Variable Differential Transformers – Variable reluctance transducers – Eddy current transducers.<br>**Applications**:<br>Displacement measurement - Thickness Measurement – Position Measurement. | | | **CO3** |
| **UNIT-IV** | **Variable Capacitance Transducers and Other Transducers** | **Periods: 09** | |
| **Capacitive Transducers**:<br>Variable area type – Variable dielectric type – Variable distance type. Applications: Capacitive Thickness Transducers–Capacitive Moisture Transducers - Capacitive Level Transducer.<br>**Other Transducers:**<br>Piezoelectric Transducers - Magnetostrictive Transducers – Hall Effect Transducers – Photo electric Transducer | | | **CO4** |
| **UNIT-V** | **Smart Sensors** | **Periods: 09** | |
| Introduction to Smart Sensors and Semiconductor sensors: MEMS, Nano-sensors, SQUID Sensors- **Applications**: Environmental Monitoring sensors (Water Quality & Air Pollution) - Sensor for Motion and Position Measurement: GPS, SONAR, Thermal Sensors. | | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. S.Vijayachitra, Transducers engineering, 2nd Edition, Prentice Hall of India, 2016.
2. Patranabis, D., “Sensors and Transducers”, 2nd Edition, Prentice Hall India Pvt. Ltd, 2010.
3. Murthy D.V.S., “Transducer and Instrumentation”, PHI, 2nd Edition, 2012.

**Reference Books**

1. Jacob Fraden , "Handbook of modern sensors physics, designs and applications", 5th edition, Springer, 2015.
2. PavelRipka, "Modern sensors handbook", ISTE Ltd, 1st edition, 2007.
3. Renganathan S., “Transducer Engineering” -Allied Publishers Limited, 2003
4. Doebelin E.A., “Measurement Systems: Applications and Design”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi,

2008.

5. Sawhney A.K., "Electrical & Electronic Measurements and Instrumentation", Dhanpat Rai & Sons,18th Edition., 2010.

**Web References**

1. https://lecturenotes.in/subject/30/sensors-and-transducers-st
2. https://lecturenotes.in/notes/2143-notes-for-sensors-and-transducers-st-by-anita-mohanty
3. https://www.electronicshub.org/sensors-and-transducers-introduction/
4. https://lecturenotes.in/notes/2143-notes-for-sensors-and-transducers-st-by-anita-mohanty

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 2 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 5 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category: **HS** | | | End Semester Exam Type: - | | | |
| Course Code | **U23HSTC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Universal Human Values -II** | **2** | **0** | **0** | **2** | **25** | **75** | **100** |
| Prerequisite | UHV-I: Universal Human Values-Introduction | | | | | | | |

| **Course Outcome** | The course will enable the student to | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Aware of themselves, and their family, society and nature. | **K2** |
| | **CO2** Be responsible in life, and in handling problems while keeping human relationships and human nature in mind. | **K2** |
| | **CO3** Apply creativity in their education and develop holistic model. | **K2** |
| | **CO4** Apply what they have learnt to their real life. | **K2** |
| | **CO5** Be proficient to provide sustainable solutions to the problems in society and nature. | **K2** |

| **UNIT-I** | **Introduction to Value Education** | **Periods:09** | |
|---|---|---|---|
| Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) - Understanding Value Education - Self-exploration as the Process for Value Education -Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario- Method to Fulfil the Basic Human Aspirations | | | **CO1** |
| **UNIT-II** | **Harmony in the Human Being** | **Periods:09** | |
| Understanding Human being as the 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-Programme to ensure self-regulation and Health | | | **CO2** |
| **UNIT-III** | **Harmony in the Family and Society** | **Periods:09** | |
| Harmony in the Family – the Basic Unit of Human Interaction- 'trust' – the Foundational Value in Relationship- 'Respect' – as the Right Evaluation-Other Feelings, Justice in Human-to-Human Relationship-Understanding Harmony in the Society- Vision for the Universal Human Order. | | | **CO3** |
| **UNIT-IV** | **Harmony in the Nature/Existence** | **Periods:09** | |
| Understanding Harmony in the 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 | | | **CO4** |
| **UNIT-V** | **Implications of the Holistic Understanding – a Look at Professional Ethics** | **Periods:09** | |
| Natural Acceptance of Human Values-Definitiveness of (Ethical) Human Conduct-: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in Professional Ethics-Holistic Technologies, Production Systems and Management Models-Typical Case Studies-Strategies for Transition towards Value-based Life and Profession | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019.

**Reference Books**


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 Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)




Dr. L. M. Varalakshmi

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **English** | | | Programme: **B.Tech.** | | | |
|---|---|---|---|---|---|---|---|
| Semester | **Second** | | | Course Category : HS | | End Semester Exam Type:**TE** | |
| Course Code | U23ENBC02 | Periods/Week | | | Credit | Maximum Marks | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Communicative English - II** | **2** | **-** | **2** | **3** | **50** | **50** | **100** |

**(Common to ALL Branches except CSBS)**

| Prerequisite | Basics of English Language | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | CO1 Draft effective written communication in professional environment | **K2** |
| | CO2 Apply the mechanics of creative writing with precision and clarity | **K3** |
| | CO3 Acquire language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation | **K2** |
| | CO4 Develop language fluency and gain self-confidence | **K3** |
| | CO5 Express thoughts and ideas with clarity and focus | **K2** |

| **UNIT-I** | **Business Correspondence** | **Periods:10** | |
|---|---|---|---|
| Business Writing: Circular, Agenda, Memoranda, Notice, Instruction, Minutes, Email Writing ,Report Writing- Official and Demi Official Letters : Applying for Educational / Car / Home Loans / Joining Report, Leave Letter, Industrial Visit, In plant Training, Letter to the Editor, Calling for a quotation, Placing Order, Letter of Complaints, Letter seeking Clarification, Resume', Job Application Letter, Bio-data, CV | | | **CO1** |
| **UNIT-II** | **Functional Writing Skills** | **Periods:10** | |
| Four Modes of Writing, Sentence Structure , Art of condensation: Summary Writing and Note Making, Use of phrase and clause in sentence, Principles of paragraph writing, Techniques of Essay Writing, Jumbled Sentence, Paraphrasing | | | **CO2** |
| **UNIT-III** | **Etiquettes** | **Periods:10** | |
| Etiquette: Meaning, Kinds: Corporate Etiquette, Meeting Etiquette, Telephone Etiquette, Email Etiquette, Social Media Etiquette, Dining Etiquette, Communication Etiquette | | | **CO3** |
| **UNIT-IV** | **Communication Practice-II** | **Periods:15** | |
| **List of Exercises**<br>**Listening:** Letter writing tips<br>**Speaking:** Just a Minute, Impromptu Speech, Contemporary Issues<br>**Reading:** Variety of examples for Modes of Writing<br>**Writing:** Different types of letters | | | **CO4** |
| **UNIT-V** | **Interpersonal Communication-II** | **Periods:15** | |
| **List of Exercises**<br>**Listening:** Videos on different types of Etiquettes<br>**Speaking:** Team Presentation, Negotiation Skills<br>**Reading:** Phrases and Clauses<br>**Writing:** Free writing on any given topic, Paraphrasing Practice | | | **CO5** |

| **LecturePeriods:30** | **Tutorial Periods: -** | **Practical Periods:30** | **Total Periods:60** |
|---|---|---|---|

**Text Books**


1. PC Das, "Letter Writing including Official and Business Letters", New Central Book Agency, 2020.
2. Kumar, Sanjay, Pushpalatha," Communication Skills". Oxford University Press, 2018.
3. Raman, Meenakshi&Sangeetha Sharma," Communication Skills", New Delhi: OUP,2018.


**Reference Books**


1. Sahukar, Nimeran , Bhalla, Prem,, "The book of Etiquettes and Manners".PustakMahal Publisher, New Delhi; 1st Edition 2009.
2. Gerson Sharon J, Steven M. Gerson, "Technical Writing Process and Product", Pearson Education Pvt. Ltd. 3rd Edition, 2009.
3. Grussendorf, Marion, "English for Presentations". Oxford University Press, Oxford, 2007.
4. Seely John, "The Oxford Guide to Writing and Speaking", Oxford University Press, 2006.
5. R.C. Sharma, Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill &Co.Ltd., New Delhi, 2001.


**Web References**

1. https://www.indeed.com/career-advice/finding-a-job/how-to-write-an-application-letter
2. https://owlcation.com/humanities/Four-Types-of-Writing
3. https://targetstudy.com/languages/english/paragraph-writing.html
4. https://www.businessnewsdaily.com/8262-email-etiquette-tips.html



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5. https://www.youtube.com/watch?v=UOceysteljo

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 2 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 3 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 4 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |
| 5 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Theory | | | | | | |
|---|---|---|---|---|---|---|
| Assessment | Continuous Assessment Marks (CAM) | | | | End Semester Examination (ESE) Marks | Total Marks |
| | CAT 1 | CAT 2 | Model Exam | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 75 | 60 |
| | 20( to be weighted for 10 marks) | | | | (to be weighted for 50 marks) | |

| Practical | | | | |
|---|---|---|---|---|
| Continuous Assessment Internal Evaluation | | End Semester Internal Evaluation | | Total Marks |
| 30(to be weighted for 10 marks) | | 30 marks | | |
| Listening (L)* | 10 | Listening (L)* | 10 | 40 |
| Speaking(S) | 5 | Speaking(S) | 5 | |
| Reading(R)* | 10 | Reading(R)* | 10 | |
| Writing(W)* | 5 | Writing(W)* | 5 | |

- **LRW components of Practical can be evaluated through Language Lab Software**

| Department | **Mechanical** | | | Programme : **B.Tech.** | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | | | Course Category: **ES** | | | End Semester Exam Type: **LE** | |
| Course Code | **U23ESPC03** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Engineering Graphics Using AutoCAD** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to all Branches)

Prerequisite: -

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Familiarize with the fundamentals and standards of engineering graphics. | **K3** |
| **CO2** | Perform drawing of basic geometrical constructions and multiple views of objects. | **K2** |
| **CO3** | Visualize the isometric and perspective sections of simple solids. | **K3** |
| **CO4** | Connect side view associate on front view. | **K4** |
| **CO5** | Correlate sectional views and lateral surface developments of various solids. | **K4** |

**List of Experiments**

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing a Title Block with necessary text and projection symbol.
3. Drawing 2D sketch by applying modify tools like fillet, mirror, array, etc.,
4. Drawing front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and Dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. Simple stool, V-block, Mixie Base).
6. Drawing a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
8. Drawing lateral surface development of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creating 3D model of simple object and obtaining 2D multi-view drawings.
11. Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**

1. James D. Bethune, Engineering Graphics with AutoCAD A Spectrum book 1st Edition, Macromedia Press, Pearson, 2020.
2. NS Parthasarathy and Vela Murali, Engineering Drawing, Oxford university press, 2015.
3. M.B Shah, Engineering Graphics, ITL Education Solutions Limited, Pearson **Education** Publication, 2011.
4. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2017.
5. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, Vikas Publishing House Pvt Ltd., 7th Edition, New Delhi, 2016.
6. C M Agrawal, Basant Agrawal, Engineering Graphics, McGraw Hill, 2012.
7. Dhananjay A. Jolhe, Engineering Drawing: With An Introduction To CAD McGraw Hill, 2016.
8. James Leach, AutoCAD 2017 Instructor, SDC Publications, 2016.

**Web References**

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php
2. http://www.nptelvideos.in/2012/12/computer-aided-design.html
3. https://mech.iitm.ac.in/meiitm/course/cad-in-manufacturing/
4. https://autocadtutorials.com
5. https://dwgmodels.com

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 1 | - | - | 3 | - | - | - | 3 | - | - | 2 | 3 | 3 | 3 |
| **2** | 3 | 1 | - | - | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| **3** | 3 | 1 | - | - | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 3 |
| **4** | 3 | 1 | - | - | 3 | - | - | - | 3 | - | - | 2 | 3 | 3 | 3 |
| **5** | 3 | 1 | - | - | 3 | - | - | - | 3 | - | - | 3 | 3 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Computer Science and Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category: **ES** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23CSPC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Programming In C Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to all Branches)

Prerequisite: -

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Implement logical formulations to solve simple problems leading to specific applications. | **K3** |
| | **CO2** Execute C programs for simple applications making use of basic constructs, arrays and strings. | **K3** |
| | **CO3** Experiment C programs involving functions, recursion, pointers, and structures. | **K3** |
| | **CO4** Demonstrate applications using sequential and random access file processing. | **K3** |
| | **CO5** Build solutions for online coding challenges. | **K3** |

**List of Exercises** **Periods:09**

1. Create a C program to find the Area of the triangle.
2. Develop a C program to read a three digit number and produce output like
   1 hundreds
   7 tens
   2 units
   For an input of 172.
3. Write a C program to check whether a given character is vowel or not using Switch – Case statement.
4. Print the numbers from 1 to 10 along with their squares using C program.
5. Demonstrate do—While loop in C to find the sum of 'n' numbers.
6. Find the factorial of a given number using Functions in C.
7. Write a C program to check whether a given string is palindrome or not?
8. Write a C program to check whether a value is prime or not?
9. Develop a C program to swap two numbers using call by value and call by reference.
10. Construct a C program to find the smallest and largest element in an array.
11. Implement matrix multiplication using C program.
12. Create a C program to perform various string handling functions like strlen, strcpy, strcat, strcmp.
13. Develop a C program to remove all characters in a string except alphabets.
14. Create a C program to find the sum of an integer array using pointers.
15. Write a C program to find the Maximum element in an integer array using pointers.
16. Construct a C program to display Employee details using Structures
17. Write a C program to display the contents of a file on the monitor screen.
18. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
19. Write a C program to create two files with a set of values. Merge the two file contents to form a single file
20. Create a C program to pass the parameter using command line arguments.

| **Lecture Periods:** | **Tutorial Periods:** | **Practical Periods:30** | **Total Periods:30** |
|---|---|---|---|

**Reference Books**

1. Zed A Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)", Addison Wesley,2016.
2. Anita Goel and Ajay Mittal," Computer Fundamentals and programming in C", Pearson Education, First edition, 2011.
3. Maureen Sprinkle Hubbard," Problem Solving and Programming Concepts," Pearson,9th Edition, 2011.
4. Yashwanth Kanethkar, "Let us C", BPB Publications,13th Edition,2008.
5. B.W.Kernighan and D.M. Ritchie, "The C Programming Language", Pearson Education, 2nd Edition, 2006.

**Web References**

1. https://alison.com/course/introduction-to-c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. https://www.tenouk.com/clabworksheet/clabworksheet.html
5. https://fresh2refresh.com/c-programming/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 2 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 3 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 4 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 5 | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | - | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |



Dr. L. M. Varalakshmi

| Department | **Biomedical Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23BMPC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Electron Devices and Circuits Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| (Common to BME and ICE Branches) | | | | | | | | |
| Prerequisite | **-** | | | | | | | |

| | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
|---|---|---|---|
| **Course Outcomes** | **CO1** | Demonstrate the characteristic of PN Junction diode and Zener diode | **K3** |
| | **CO2** | Construct and analyze the applications of diodes | **K4** |
| | **CO3** | Analyze the characteristics of different types of transistors and special diodes. | **K4** |
| | **CO4** | Design the LC oscillators and analyze the frequency response of CE amplifier. | **K4** |
| | **CO5** | Simulate the power amplifiers and feedback amplifiers. | **K3** |

**List of Experiments:**

1. Characteristics of PN Junction Diode and Zener Diode.
2. Analysis of Half wave and Full wave Rectifiers.
3. Analysis of wave shaping circuits (Clippers and Clampers).
4. Characteristics of LED and Photo diode.
5. Characteristics of BJT in CB configuration
6. Characteristics of BJT in CE configuration
7. Characteristics of JFET
8. Negative resistance characteristics of UJT
9. Characteristics of Thyristors
10. Study the frequency response of CE Amplifier.
11. Design and Testing of LC Oscillators.
12. Simulation of Power Amplifiers and Feedback Amplifiers.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods:30** |
|---|---|---|---|

**Reference Books**

1. Srinivasa Murthy, “Electronic Devices and Circuits Laboratory Manual”, 4th Edition, October 2015
2. David A.Bell,” Lab Manual For Electronic Devices & Circuits”, Fourth edition, PHI learning private limited, January 2004
3. Robert Boylestad , Louis Nashelsky, Franz Monssen ,“ Lab Manual for Electronic Devices and Circuit Theory”, Pearson, 11th Edition, August 2012.
4. Maheswari. L.K and Anand.M.M.S, “Laboratory Manual for Introductory Electronic Experiments”, New Age, 2010.
5. Muhammad H. Rashid “Introduction to PSpice using OrCAD for circuits and electronics, Pearson, 3rd Edition , 2004.

**Web References**

1. www.allaboutcircuits.com
2. www.circuitstoday.com
3. www.tutorialspoint.com

* TE – Theory Exam, LE – Lab Exam



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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | 2 | 2 | 1 | - | - | 2 | - | - | 1 | 3 | 1 | 2 |
| 2 | 3 | 2 | 2 | 2 | 2 | 2 | - | - | 2 | - | - | 1 | 3 | 1 | 2 |
| 3 | 3 | 2 | 2 | 3 | 2 | 1 | - | - | 2 | - | - | 1 | 3 | 1 | 2 |
| 4 | 3 | 2 | 2 | 3 | 2 | 2 | - | - | 2 | - | - | 2 | 3 | 2 | 2 |
| 5 | 3 | 2 | 2 | 3 | 2 | 2 | - | - | 2 | - | - | 1 | 3 | 1 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |



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| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category Code: **PC** | | | End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP203** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Transducer Engineering Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| | | | | | | | | |

| Prerequisite | Basics in Electronics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Acquaint knowledge on strain gauge, potentiometer and load cell | **K2** |
| | **CO2** Analyze and understand the static and dynamic characteristics of thermocouple, thermistor and RTD. | **K3** |
| | **CO3** Demonstrate the performance characteristics of capacitive and inductive type of transducers. | **K3** |
| | **CO4** Acquire knowledge on energy harvesting transducers. | **K3** |
| | **CO5** Select suitable sensors and transducers for various applications. | **K3** |

**List of Experiments:**

1. Characteristics of Strain gauge and load cell.
2. Characteristics of potentiometer.
3. Characteristics of temperature transducer using RTD, Thermistor and Thermocouple.
4. Characteristics of Filled in system thermometer
5. Characteristics of LVDT.
6. Angular displacement Measurement using capacitive transducers.
7. Speed measurement using photoelectric tachometer.
8. Pressure measurement using piezoelectric transducers.
9. Measurement of Voltage, Current and Power using Hall Effect Sensor.
10. Characteristics of I /P Converters.
11. Characteristics of Optical Transducers.
12. Measurement of position and error detector using synchro transmitter and Receiver

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods:3 0** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**

1. Handbook of Laboratory Measurements and Instrumentation IFSA Publishing (2011)
2. Sawhney. A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai & Company Private Limited, 2017.
3. Renganathan. S, "Transducer Engineering", 4th edition Allied Publishers, Chennai, 2003.
4. Sensors and transducers by Patranabis, 2nd Edition, 2003.
5. John G. Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2nd Edition, 2008

**Web References**

1. https://lecturenotes.in/subject/30/sensors-and-transducers-st
2. https://lecturenotes.in/notes/2143-notes-for-sensors-and-transducers-st-by-anita-mohanty
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | - | 1 | - | - | 2 | 2 | - | 2 | - | 2 | 1 | 3 | 3 | 3 |
| 2 | 3 | - | 1 | - | - | 2 | 2 | - | 2 | - | 2 | 1 | 3 | 3 | 3 |
| 3 | 3 | - | 1 | - | - | 2 | 2 | - | 2 | - | 2 | 1 | 3 | 3 | 3 |
| 4 | 3 | - | 1 | - | - | 2 | 2 | - | 2 | - | 2 | 1 | 3 | 3 | 3 |
| 5 | 3 | - | 1 | - | - | 2 | 2 | - | 2 | - | 2 | 1 | 3 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |



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| U23ICC2XX | CERTIFICATION COURSE - II | L | T | P | C | Hrs |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 4 | - | 50 |

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | Total Marks |
|---|---|---|---|
| | Attendance | MCQ Test | |
| Marks | 10 | 90 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **II** | Course Category: **MC** | | | End Semester Exam Type: - | | | |
| Course Code | **U23ICM202** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Sports Yoga and NSS** | 0 | 0 | 2 | Non-Credit | 100 | - | 100 |
| Prerequisite | **-** | | | | | | | |

| | | | BT Mapping (Highest Level) |
|---|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | | |
| | **CO1** | Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility and relaxation. | **K2** |
| | **CO2** | Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination. | **K2** |
| | **CO3** | Develop understanding of psychological problems associated with age and lifestyle. | **K2** |
| | **CO4** | Recognize the importance of national service in community development. | **K2** |
| | **CO5** | Convert existing skills into socially relevant life skills. | **K2** |

| **UNIT-I** | **Introduction To Physical Education** | **Periods: 06** | |
|---|---|---|---|
| Definition, Aims and Objectives of Physical Education - Changing trends in Physical Education<br>**Physical Fitness, Wellness and Lifestyle:** Importance of Physical Fitness and Wellness - Components of Physical fitness - Components of Health related fitness - Components of wellness - Preventing Health Threats through Lifestyle Change - Concept of Positive Lifestyle. | | | **CO1** |
| **UNIT-II** | **Yoga And Lifestyle** | **Periods: 06** | |
| Importance of Yoga - Elements of Yoga - Introduction - Asanas, Pranayama, Meditation and Yogic Kriyas - Yoga for concentration and related Asanas (Sukhasana, Tadasana, Padmasana and Shashankasana) - Relaxation Techniques for improving concentration - Yog-nidra. Asanas as preventive measures – Hypertension – Obesity - Back Pain-Diabetes - Asthema. | | | **CO2** |
| **UNIT-III** | **Training And Planning In Sports** | **Periods: 06** | |
| Training - Warming up and limbering down-Skill, Technique and Style - Objectives of Planning – Tournament - Knock-Out, League/Round Robin and Combination.<br>**Psychology and Sports** - Important of Psychology in Physical Education and Sports - Differentiate Between Growth and Development - Adolescent problems and their Management - Emotion: Concept, Type and Controlling of emotions -Concepts and Types of Aggressions in Sports - Psychological benefits of exercise - Anxiety and Fear and its effects on Sports Performance - Motivation, its type and techniques - Understanding Stress and Coping strategies | | | **CO3** |
| **UNIT-IV** | **Introduction To National Service Scheme** | **Periods: 06** | |
| Orientation of NSS volunteers: History, motto, symbol, awards, structure and activities of NSS - Days of National and International Importance - Sensitizing about the thrust areas and awareness activities - Importance of tree plantation and voluntary blood donation - The role of SHGs and NGOs in community development – CSR - Life skills and youth development-extension activities in HEIs - various clubs and schemes like RRC, ELC, YRC, UBA, SBA, etc., | | | **CO4** |
| **UNIT-V** | **Community Issues And The Use Of Technology** | **Periods: 06** | |
| Common Problems of rural India - Technology development and its suitability – Sustainability - Value addition to agricultural products - Service learning and youth volunteering – Shramdaan - Campus cleaning - Field visit to nearby communities - village survey - Initiatives to clean and green environment - preservation of water bodies in adopted villages. | | | **CO5** |

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**

1. Brar Ajmer Singh, Gill Jagtar Singh, Bains Jagdish, “Modern Textbook of Physical Education Health and Sports- I”, Kalyani Publishers , 6th Edition, 2014.
2. B.K.S. Iyengar, “Light on Yoga: The Definitive Guide to Yoga Practice”,Thorsons Publishers, Thorsons Classics edition, 2015.
3. Joseph, Siby K, Mahodaya, “Bharat Essays on Conflict Resolution”, Institute of Gandhian Studies Publishers, 2007.
4. Barman Prateeti , Goswami, “Document on Peace Education”, Triveni Akansha Publishing House, New Delhi, 2009.
5. Prof R.B.S. Verma, “Field Work Practicum in Social Work-Emerging Concerns”, Rapid Publisher, Lucknow, 2020.
6. Sibereisen, K , Richard M, “Lerner Approaches to Positive Youth Development”, Sage Publications, New Delhi, 2007.
7. Hoshiar Singh, “Administration of Rural Development in India”,Sterling Publisher, the University of Michigan, 2009.

**Web References**

1. http://www.thebetterindia.com/140/national-service-scheme-nss
2. http://en.wikipedia.org/wiki/national-service-scheme 19=http://nss.nic.in/adminstruct

3. http://nss.nic. in
4. http://socialworknss.org/about.html
5. Young Journal on Youth published by SAGE: http://you.sagepub.com

**Evaluation methods**

| Assessment | Continuous Assessment Marks (CAM) | | | Total Marks |
|---|---|---|---|---|
| | **Attendance** | **MCQ Test** | **Presentation / Activity / Assignment** | |
| Marks | 10 | 30 | 60 | 100 |



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Mathematics** | | | Programme: **B.Tech.** | | | | |
| Semester | **III** | | | Course Category Code: **BS** | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23MATC03** | | | Periods/Week | | | Credit | Maximum Marks |
| | | | | L | T | P | C | CAM / ESE / TM |
| Course Name | **Probability and Statistics** | | | **3** | **1** | **-** | **4** | **25 / 75 / 100** |

(Common to All Branches Except CSBS)

| | | | |
|---|---|---|---|
| Prerequisite | Basic Probability | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Apply the concept of probability. | **K3** |
| | **CO2** | Solve the problem on Random variables. | **K3** |
| | **CO3** | Evaluate the correlation and Regression. | **K3** |
| | **CO4** | Find Correlation between variables. | **K3** |
| | **CO5** | Analyze the problems in small samples. | **K3** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Theory of Probability** | **Periods:12** | |
| Random Experiments - Sample Space - Exhaustive events- Axioms of probability – Conditional probability – Total probability – Bayes theorem. | | | **CO1** |
| **UNIT – II** | **Random Variables** | **Periods:12** | |
| Moments–Moment generating functions and their properties. Binomial distribution – Poisson distribution – Exponential distribution – Normal distribution (Excluding Derivation of Mean, Variance and MGF) | | | **CO2** |
| **UNIT – III** | **Design of Experiments** | **Periods:12** | |
| Analysis of variance: One way and two-way classifications. Correlation – Rank correlation and Regression. | | | **CO3** |
| **UNIT – IV** | **Large Samples** | **Periods:12** | |
| Large Samples: Single Propositions – Difference of Proportions – Single Mean – Difference of Mean – Difference of Standard Deviations | | | **CO4** |
| **UNIT – V** | **Small Samples** | **Periods:12** | |
| Test for Mean – Test for Ratio of Variances – Chi-Square test for Goodness of Fit and Independence of Attributes. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:15** | **Practical Periods:-** | **Total Periods:60** |

**Text Books**

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna publishers, 3rd Edition,2017.
2. T. Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw-Hill, 3rd Edition, 2008.
3. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, 2019.

**Reference Books**

1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", McGraw-Hill, 1stEdition, 2017.
2. William Mendenhall, Robert J. Beaver and Barbara M. Beaver: "Introduction to Probability & Statistics", Cengage Learning, 15thEdition, 2019.
3. Richard. A. Johnson, Irwin Miller and John E. Freund," Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.
4. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, "An Introduction to Probability and Statistics", Wiley, 3rd Edition 2008.

**Web References**

1. www.stat110.net
2. http://www.nptel.ac.in/courses/111105035 (R.V)
3. http:// www.probabilitycourse.com.
4. www.edx.org/Probability
5. http://www2.aueb.gr/users/demos/pro-stat.pdf

* TE – Theory Exam, LE – Lab Exam

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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 2 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 3 | 2 | 2 | - | - | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 4 | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 5 | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Artificial Intelligence and Data Science** | Programme: **B.Tech** | | | | | | |
| Semester | **III** | Course Category Code: **ES** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ADTC01** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Programming in Python** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to All Branches)

| | | | |
|---|---|---|---|
| Prerequisite | NIL | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Interpret the basic concepts of Python programs. | **K2** |
| | **CO2** | Articulate the concepts of Sets, Dictionaries and Object-Oriented concepts. | **K2** |
| | **CO3** | Experiment with Numpy package. | **K3** |
| | **CO4** | Apply and analyze Data Manipulation with Pandas. | **K3** |
| | **CO5** | Illustrate programming concept for Visualization with Matplotlib. | **K3** |

| | | | |
|---|---|---|---|
| **UNIT-I** | **Introduction To Python** | **Periods: 09** | |
| Structure of Python Program – Underlying mechanism of Module Execution – Branching and Looping – Problem Solving Using Branches and Loops – Functions – Lambda Functions – Lists and Mutability – Problem Solving Using Lists and Functions. | | | **CO1** |
| **UNIT-II** | **Sequence Datatypes and Object-Oriented Programming** | **Periods: 09** | |
| Sequences – Mapping and Sets – Dictionaries. Classes: Classes and Instances – Inheritance – Exception Handling – Introduction to Regular Expressions using "re" module. | | | **CO2** |
| **UNIT-III** | **Using Numpy** | **Periods: 09** | |
| Basics of NumPy – Computation on NumPy – Aggregations – Computation on Arrays – Comparisons – Masks and Boolean Arrays – Fancy Indexing – Sorting Arrays – Structured Data: NumPy's Structured Array. | | | **CO3** |
| **UNIT-IV** | **Data Manipulation with Pandas** | **Periods: 09** | |
| Introduction to Pandas Objects – Data indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Combining Data Sets. Aggregation and Grouping – Pivot Tables –Vectorized String Operations – Working with Time Series – High Performance Pandas – eval() and query(). | | | **CO4** |
| **UNIT-V** | **Visualization With Matplotlib** | **Periods: 09** | |
| Basic functions of Matplotlib – Simple Line Plot – Scatter Plot – Density and Contour Plots – Histograms – Binnings and Density – Customizing Plot Legends – Colour Bars – Three-Dimensional Plotting in Matplotlib. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods: 45** | **Tutorial Periods:** | **Practical Periods: -** | **Total Periods: 45** |

**Text Books**

1. Jake VanderPlas, "Python Data Science Handbook - Essential Tools for Working with Data", O'Reily Media Inc, 2016.
2. Zhang.Y, "An Introduction to Python and Computer Programming", Springer Publications, 2016.
3. Wesley J Chun, "Core Python Programming", Pearson Education, 2nd Edition, 2006.

**Reference Books**

1. John Paul Mueller, Luca Massaron, "Python for Data Science for Dummies", 2nd Edition, John Wiley& Sons, 2019.
2. Jesus Rogel-Salazar, "Data Science and Analytics with Python", CRC Press Taylor and Francis Group, 2017.
3. Brian Draper, "Python Programming A Complete Guide for Beginners to Master and Become an Expert in Python Programming Language", CreateSpace Independent Publishing Platform, 2016.
4. Mark Lutz, Laura Lewin, Frank Willison, "Programming Python", O'Reilly Media, 3rd Edition, 2006.
5. Gowrishankar S, Veena A, "Introduction to Python Programming", CRC Press, 2018.

**Web References**

1. https://nptel.ac.in/courses/106/106/106106212/
2. https://www.geeksforgeeks.org/data-analysis-visualization-python/
3. https://www.coursera.org/learn/python-data-analysis
4. https://www.python.org/
5. https://www.programiz.com/python-programming

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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | - | 3 | - | 3 |
| 2 | 2 | 2 | 1 | 3 | - | - | - | - | - | - | - | 2 | 2 | 2 | 3 |
| 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 2 | 3 | 2 | 3 |
| 4 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 | 3 |
| 5 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 2 | 3 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category: PC | | | | End Semester Exam Type: **TE** | | |
| Course Code | **U23ICTC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Linear Integrated Circuits** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to ICE & BME Branches)

| Prerequisite | Basic Electronics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Acquire knowledge on the basic operation of Operational Amplifier | **K2** |
| | **CO2** Understand the applications of Operational Amplifier | **K3** |
| | **CO3** Gain knowledge on the operation of comparators and waveform generators | **K3** |
| | **CO4** Design first order active filters and understand the concepts of data converters | **K4** |
| | **CO5** Acquaint with the basics of timer IC, Phase Locked Loops and Voltage regulators. | **K3** |

| **UNIT – I** | **Op-amp and its Characteristics** | **Periods:09** | |
|---|---|---|---|
| Basics of operational amplifier (op amp) and its ideal characteristics, Internal Building Block, Inverting and non-inverting amplifier, Voltage follower, Differential Amplifier, DC characteristics and AC characteristics. | | | **CO1** |
| **UNIT – II** | **Op-amp Applications** | **Periods:09** | |
| Basic Op Amp Applications- Summing Amplifier, Subtractor, Differentiator and Integrator, Half wave rectifier and Full wave rectifier, Peak detector, Clipper and Clamper, Sample and hold circuit, log amplifier, Instrumentation amplifier, V-I and I-V converter. | | | **CO2** |
| **UNIT – III** | **Comparators and Waveform Generators** | **Periods:09** | |
| Comparator and its applications - Schmitt trigger, Astable multivibrator, Monostable multivibrator, Triangular wave generator, Sawtooth wave generator, RC Phase shift oscillator, Wien bridge oscillator. | | | **CO3** |
| **UNIT – IV** | **Active Filters and Data Converters** | **Periods:09** | |
| **Active Filters:** First order low pass and high pass filter, Band Pass Filter, Band Stop Filter.<br>**Digital to Analog converters (DAC):** Weighted Resistor DAC, R-2R ladder DAC, Inverted R-2R DAC.<br>**Analog to Digital converters (ADC):** Flash type ADC, Successive approximation ADC, Dual slope ADC. | | | **CO4** |
| **UNIT – V** | **Timer, PLL and Voltage Regulators** | **Periods:09** | |
| 555 timer IC pin diagram and functional diagram, 555 timer in monostable mode and its application as pulse width modulation, 555 timer in astable mode and its application as frequency shift keying (FSK), Phase Lock Loop IC 565.<br>**Voltage Regulators:** Series op-amp regulator, LM78XX, 79XX fixed voltage regulator, 723 General Purpose Regulator, Switched Mode Power Supply (SMPS). | | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. D Roy Choudhury and Shail B. Jain, “Linear integrated circuits”, New Age Science Limited, Fourth edition, 2018
2. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, Fourth Edition, Prentice Hall / Pearson Education, 2015
3. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH, 2010.

**Reference Books**

1. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Fourth Edition,Tata Mc Graw-Hill, 2016.
2. S.Salivahanan& V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, Second Edition, TMH, 4th Reprint, 2016.
3. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2008.
4. B.S.Sonde, “System design using Integrated Circuits”, Second Edition, New Age Pub, 2010
5. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2009.

**Web References**

1. http://www.ti.com/applications/industrial/medical/technical-documents.html
2. https://e-box.co.in/linear-integrated-circuits.shtml
3. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.html

* TE – Theory Exam, LE – Lab Exam



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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | - | 1 | 3 | 1 | - |
| 2 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 1 | - |
| 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | 1 | 3 | 1 | - |
| 4 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 1 | - |
| 5 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | - | 1 | 3 | 1 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **III** | Course Category: **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICTC02** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Digital Logic Circuits** | **2** | **1** | **0** | **3** | **25** | **75** | **100** |
| (Common to ICE & BME Branches) | | | | | | | | |
| Prerequisite | **-** | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Interpret the concepts of number systems and binary codes. | **K2** |
| | **CO2** Analyze the operations of boolean algebra and logic gates. | **K3** |
| | **CO3** Design and implement combinational logic circuits | **K3** |
| | **CO4** Design and implement sequential logic circuits | **K3** |
| | **CO5** Acquaint with memory devices, Programmable Logic Devices and Logic families | **K3** |

| **UNIT – I** | **Number Systems and Binary Codes** | **Periods: 09** | |
|---|---|---|---|
| **Number Systems-**Binary, Octal, Decimal, Hexadecimal. Number system conversions, Binary Arithmetic, Representation of signed binary numbers, 1s and 2s Complements.<br>**Binary Codes -** Classification, Binary coded decimal (BCD), Weighted, and Non weighted, Reflective, sequential, Alphanumeric codes. Error detection codes. Error correction codes. | | | **CO1** |
| **UNIT – II** | **Boolean Algebra and Logic Gates** | **Periods: 09** | |
| **Boolean Algebra:** Basic Theorems and Properties, Standard Forms of Boolean Expression-Sum of Product(SOP), Product of Sum(POS), Canonical and Standard forms, Simplification of Boolean expressions - Algebraic simplification, Karnaugh-Map simplification, Quine McClusky simplification.<br>**Logic gates:** Basic logic gates ; Universal gates ;Implementation of Boolean function using gates | | | **CO2** |
| **UNIT – III** | **Combinational Logic Circuits** | **Periods:09** | |
| Binary adders- Half adder, Full adder, Parallel Adder, Look ahead carry adder, Binary Subtractors - Half subtractor, Full subtractor, 1bit and 2bit Magnitude comparators, Code converters, Decoders and encoders, Multiplexers and Demultiplexers, Parity bit generator and checker. | | | **CO3** |
| **UNIT – IV** | **Sequential Logic Circuits** | **Periods:09** | |
| Types of sequential circuits, Comparison between combinational and sequential circuits, Latches-RS latch; Flip flops(FF) – RS,D, JK, and T, JK Master/Slave FF, triggering of flip flops, Excitation tables, Flip flop conversions. Design of Counters- Asynchronous(Ripple) Counters, synchronous counters, Shift registers, Classification of shift registers, Universal Shift Register, Ring Counter, Johnson counter. | | | **CO4** |
| **UNIT – V** | **Memory, Programmable Logic Circuits and Logic Families** | **Periods:09** | |
| **Memory** Classification- Random Access Memory (RAM), Static RAM, Dynamic RAM, Read Only Memory (ROM); PROM, EPROM, EEPROM.<br>**Programmable Logic Devices**: Programmable ROM (PROM), Programmable Array Logic (PAL), Programmable Logic Array (PLA), Implementation of combinational circuits using PROM, PAL, PLA.<br>**Logic families**: Characteristics - propagation delay, power dissipation, fan-in, fan-out, noise margin, TTL, ECL, CMOS. | | | **CO5** |

| **Lecture Periods: 30** | **Tutorial Periods: - 15** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. M. Morris Mano, Digital Design, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
2. Anand Kumar, Fundamentals of Digital Circuits Prentice Hall of India, Pvt Ltd, New Delhi, Second Edition, 2014.
3. R.P. Jain, Modern Digital Electronics, Fourth edition, Tata McGraw Hill, 2010.

**Reference Books**

1. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 6th Edition, TMH, 2003.
2. Charles H. Roth, Larry L. Kinney, Raghunandan G.H. Fundamentals of Logic Design, Cengage Learning India Pvt. Ltd.; 1st edition, 1 September 2019
3. William H. Gothmann, Digital Electronics Prentice Hall, 2001
4. John M. Yarbrough, Digital logic: Applications and Design Thomas Vikas Publishing House, 2002.
5. Ananda Natarajan R, Digital Design, Second edition, Eastern Economy Editions, PHI Learning Pvt. Ltd., 2015.

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1. https://nptel.ac.in/courses/117106086/
2. https://learn.ni.com/teach/resources/1104/digital-electronics
3. http://nptel.ac.in/courses/117/106/117106086/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **2** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **3** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **4** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **5** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



| Department | INSTRUMENTATION AND CONTROL ENGINEERING | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category: **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT303** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Electrical and Electronic Instrumentation** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | Basic Electronics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Understand the principle and operation of electrical instruments and measurement | **K2** |
| | **CO2** Develop skills in power and energy measurement techniques. | **K3** |
| | **CO3** Understand the measurement of resistance, inductance, and capacitance in circuits. | **K3** |
| | **CO4** Evaluate the performance of instruments under various operating conditions | **K3** |
| | **CO5** Develop the ability to select appropriate instruments for specific applications. | **K3** |

| **UNIT – I** | **Electrical Measurements** | **Periods:9** | |
|---|---|---|---|
| Basics of Measurements, General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron, dynamometer type, rectifier type, thermal instruments. Errors and compensation, Extension of instrument range: shunt and multipliers, calibration of voltmeter and ammeters, CT and PT. | | | **CO1** |
| **UNIT – II** | **Measurement of Power and Energy** | **Periods:9** | |
| Electro-dynamic wattmeter, Low Power Factor (LPF) wattmeter, errors, Single and three phase power measurement, Hall Effect wattmeter, thermal type wattmeter. Energy measurement - Single phase and polyphase induction type energy meter - theory and adjustments - Principle of operation of single-phase energy meter, Creep in energy meter and its compensation, testing of energy meter, Phantom loading- Calibration of wattmeter and energy meter | | | **CO2** |
| **UNIT – III** | **Measurement of Resistance, Inductance and Capacitance** | **Periods:9** | |
| Measurement of Resistance: Wheatstone's bridge, Sensitivity, Limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger. Measurement of Inductance and Capacitance: Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance and capacitance bridge, Hay's bridge, Anderson's bridge, Schering bridge. Application of AC bridges. Introduction to cable fault and eddy current measurement. | | | **CO3** |
| **UNIT – IV** | **Electronic and Digital Measurements** | **Periods:9** | |
| Introduction essentials of electronic instruments, Advantages of electronic instruments. True RMS reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, Continuous – balance DVM and Successive - approximation DVM. Q meter. Principle of working of electronic energy meter (block diagram treatment), Extra features offered by present day meters and their significance in billing. | | | **CO4** |
| **UNIT – V** | **Display Devices, Waveform Generators and Analyzers** | **Periods:9** | |
| DSO, DPO, MSO, Analog Recorders – Strip Chart and X-Y recorders, Digital Recorders Function generators, Signal generators, Waveform analyzers, Spectrum analyzers, Distortion analyzers. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. Golding, E.W. and Widdis, F.C., "Electrical Measurements and Measuring Instruments", A.H. Wheeler and Co, 5th Edition, 2011.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press, 2013.
3. Shawney A K, "A course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons.19th revised edition, 2014.

**Reference Books**

1. Kalsi.H.S, "Electronic Instrumentation", Tata McGraw Hill Education Private Limited, 3rd Edition, 2012.
2. Patranabis, Principles of Electronic Instrumentation - PHI, 2008
3. Joseph. J. Carr, Elements of Electronic Instrumentation & Measurements, III edition, Pearson Education, 2003.
4. Albert D.Helfrick & William D. Cooper, Modern Electronic Instrumentation & Measurement Techniques, Prentice Hall of India, 2002.
5. Doebelin, E.O., Measurement systems, McGraw Hill, Sixth edition, 2017.

**Web References**

1. https://lecturenotes.in/subject/265/electrical-measurement-and-instrumentation-emi
2. http://www.brainkart.com/subject/Measurements-and-Instrumentation_204/
3. https://onlinecourses.nptel.ac.in/noc19_ee44/preview
4. https://www.careerride.com/mcq/electrical-and-electronic-measurements-instrumentation-electrical-engineering-mcq-questions-and-answers-272.aspx

* TE – Theory Exam, LE – Lab Exam

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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| 2 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| 3 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| 4 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| 5 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | INSTRUMENTATION AND CONTROL ENGINEERING | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category: **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICB301** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Circuit Theory** | **2** | **0** | **2** | **3** | **50** | **50** | **100** |

| Prerequisite | Basics of Maths | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Gain knowledge on the basic concepts of electrical circuits | **K2** |
| | **CO2** Apply the Network Theorems. | **K3** |
| | **CO3** Explore the steady state analysis of circuits | **K4** |
| | **CO4** Simulate the network reduction laws and theorems on DC circuits | **K3** |
| | **CO5** Simulate the frequency response of resonant circuits with AC supply. | **K3** |

| **UNIT – I** | **DC Fundamental** | **Periods:10** | |
|---|---|---|---|
| Electrical Quantities- Types of Network: Linear and nonlinear, unilateral, bilateral, lumped, distributed. Ohm's Law, Resistors in Series and parallel Combinations - voltage and current division, Source: Voltage and Current Source - Ideal and Practical source - Dependent and Independent Source. Kirchhoff's Laws. Mesh and node Analysis. | | | **CO1** |
| **UNIT – II** | **Network Reduction and Theorems (DC Circuits)** | **Periods:10** | |
| Source Transformation: Current to Voltage, Voltage to Current. Network reduction – star delta conversion. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer Theorem, Reciprocity Theorem. | | | **CO2** |
| **UNIT – III** | **Steady State Analysis and Transient Analysis** | **Periods:10** | |
| Steady state analysis of RL, RC and RLC Series Circuits. Transient response of RL, RC & RLC Networks with DC Input - Solution using Laplace transforms. RL and RC Decaying Transient | | | **CO3** |
| **UNIT – IV** | | **Periods:15** | |
| **List of Exercises : Both DC and AC Input**<br>1. Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.<br>2. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.<br>3. Simulation and experimental verification of electrical circuit problems using Norton's theorem.<br>4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.<br>5. Simulation and experimental verification of Maximum Power transfer Theorem | | | **CO4** |
| **UNIT – V** | | **Periods:15** | |
| **List of Exercises**<br>1. Simulation and Experimental validation of RL and RC electric circuit transients.<br>2. Simulation and Experimental validation of frequency response of RLC electric circuit.<br>3. Design and Simulation of series and parallel resonance circuit.<br>4. Determination of self, mutual inductance and co efficient of coupling<br>5. Study of Analog and digital oscilloscopes and measurement of average value, RMS value, form factor and peak factor of sinusoidal waveform | | | **CO5** |

| **Lecture Periods: 30** | **Tutorial Periods:** | **Practical Periods: 30** | **Total Periods: 60** |
|---|---|---|---|

**Text Books**

1. Sudhakar and Shyam Mohan Palli, "Circuits and Networks; Analysis and Synthesis", 5rd Edition, Tata McGraw Hill Education, 2017
2. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 9th Edition, 2020.
3. M.E.VanValkenburg "Network Analysis", Third Edition, Prentice Education, 2019



**Reference Books**

1. Joseph Edminister and MahmoodNahvi, “Electric Circuits”, Schaum’s Outline Series, Seventh Edition, Tata McGraw Hill, 2017.
2. P. Ramesh Babu, “Circuit theory” Second Edition, Scitech Publications Pvt. Ltd, 2014.
3. N.C. Jagan&C.Lakshminarayana, ‘Network Theory’ B.S Publications, 2006.
4. Kuriakose, “Circuit Theory”, PHI Learning, 2005.
5. Allan.H.Robbins, Wilhelm C.Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013

**Web References**

1. https://lecturenotes.in/subject/265/electrical-measurement-and-instrumentation-emi
2. http://www.brainkart.com/subject/Measurements-and-Instrumentation_204/
3. https://onlinecourses.nptel.ac.in/noc19_ee44/preview
4. https://www.careerride.com/mcq/electrical-and-electronic-measurements-instrumentation-electrical-engineering-mcq-questions-and-answers-272.aspx

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 1 | 2 |
| 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 1 | 2 |
| 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 1 | 2 |
| 4 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 1 | 2 |
| 5 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 3 | 1 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Assessment method for theory cum practical course**

| Assessment | Continuous Assessment Marks (CAM) – Maximum 50 Marks | | | | | | | | | End Semester Examination (ESE) Marks (Theory) | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continuous Assessment (Theory) | | | | | Continuous Assessment (Practical) | | | | | |
| | CAT 1 | CAT 2 | Model | Attendance | Total | Conduction of Practical | Report | Viva | Total | # End Semester Examination (ESE) Marks (Practical – Internal Evaluation) | |
| Marks | 5 | 5 | 5 | 5 | 20 * | 15 | 10 | 5 | 30* | 30 | 75** | - |
| *To be weighted for 10 Marks | | | | | 10 | *To be weighted for 10 Marks | | | 10 | | **To be weighted for 50 Marks | 100 |

# Final End Semester practical exam to be conducted with internal and external examiner by Head of the institutionand HoD.

| Department | **English** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category Code: **HS** | | | *End Semester Exam Type:**LE** | | | |
| Course Code | **U23ENPC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **General Proficiency - I** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to ALL Branches except CSBS)

| Prerequisite | Basics of English Language | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Interpret meaning and apply reading strategies in technical and non-technical context | **K3** |
| | **CO2** Develop interpersonal communication skills professionally | **K4** |
| | **CO3** Demonstrate various forms of formal writing | **K3** |
| | **CO4** Decode graphical data coherently | **K2** |
| | **CO5** Apply the techniques of verbal aptitude in competitive exams | **K3** |

| **UNIT- I** | **Comprehension Analysis** | **Periods:6** | |
|---|---|---|---|
| Listening: Dialogue based on social contexts (IELTS based) - Speaking: Break the iceberg (IELTS based) Submitting Video Recording - Reading: Reading technical passage (IELTS based) - Writing: Writing Task: 2 (IELTS Academic) - Vocabulary: Synonyms (IELTS) | | | **CO1** |
| **UNIT- II** | **Personality Development** | **Periods:6** | |
| Listening: Monologue about the everyday social issues (IELTS based) - Interview Videos - Speaking: Speak about the topic in the Flash Card (IELTS based) - Reading: British & American Vocabulary - Writing: SWOT Analysis - Vocabulary: Idioms and Phrases (IELTS) | | | **CO2** |
| **UNIT- III** | **Inferential Learning** | **Periods:6** | |
| Listening: Conversation between 4 people regarding education (IELTS based), Anecdotes - Speaking: Structure Discussion (IELTS based) - Reading: Distinguish between facts & opinions (IELTS based), - Writing: Writing Conversation to different context - Vocabulary: Phrasal Verbs (IELTS) | | | **CO3** |
| **UNIT- IV** | **Interpretation and Functional Writing** | **Periods:6** | |
| Listening: Monologue on an academic subject (IELTS based), Group Discussion videos - Speaking: Group Discussion Practice - Reading: Read and review (Books, Magazines) - Writing: Writing Task 1: (IELTS Academic: Graph/ chart/tables description) - Vocabulary: Collocations (IELTS) | | | **CO4** |
| **UNIT-V** | **Verbal Aptitude - I** | **Periods:6** | |
| **Language Enhancement:** Articles, Preposition, Conjunction<br>**Verbal Ability Enhancement:** Ordering of sentences, Blood Relation, Completing Statements- Cloze test, Spotting Errors - Sentence Improvement, Word Analogy, Word Groups **(GATE)** | | | **CO5** |

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods:30** | **Total Periods:30** |
|---|---|---|---|

**Reference Books**


1. Lewis, Norman, "Word Power Made Easy".Goyal Publishers and Distributors Pvt.Ltd., Latest Edition, 2020.
2. Patterson,Kerry, Joseph Grenny,Ron McMillan, Al Switzler, "Crucial Conversation Tools for talking when Stakes are High", Kindle Publication,2nd Edition, 2011.
3. Comfort, Jeremy,et.al. "Speaking Effectively: Developing Speaking Skills for Business English", Cambridge University Press, Cambridge: Reprint 2011.
4. Agarwal, R. S. "A Modern Approach to Verbal & Non Verbal Reasoning". S. Chand, 2010.
5. Wren, Percival Christopher, and Wren Martin. "High School English Grammar and Composition". S Chand, 2005.


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1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers



Dr. L. M. Varalakshmi

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 1 | - | - | - | - | - | - | 1 | - | 3 | - | 2 | 1 | 1 | 1 |
| 2 | 1 | - | - | - | - | - | - | 1 | - | 3 | - | 2 | 1 | 1 | 1 |
| 3 | 1 | - | - | - | - | - | - | 1 | - | 3 | - | 2 | 1 | 1 | 1 |
| 4 | 1 | - | - | - | - | - | - | 1 | - | 3 | - | 2 | 1 | 1 | 1 |
| 5 | 1 | - | - | - | - | - | - | 1 | - | 3 | - | 2 | 1 | 1 | 1 |

**Correlation Level: 1-Low, 2-Medium, 3-High**

**Evaluation Method**

| Practical | | | | |
|---|---|---|---|---|
| **Continuous Assessment Internal Evaluation** | | **End Semester External Evaluation** | | **Total Marks** |
| **50 marks** | | **50 marks** | | 100 |
| Conduction of Practical<br>(Assignment 1&2 -10 Marks<br>Performance in practical classes - 5 Marks) | 15 | Listening (L) | 20 | |
| Record | 5 | Speaking(S) | 10 | |
| Viva | 5 | Reading(R) | 10 | |
| Model Practical Examination<br>(Model Exam is conducted for 50 Marks that will be converted to 15 Marks) | 15 | Writing(W) | 10 | |
| Attendance | 10 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Mathematics** | Programme: **B.Tech.** | | | | | | |
| Semester | **III** | Course Category Code: **BS** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23MAPC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Engineering Mathematics Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| (Common to all Branches Except CSBS) | | | | | | | | |
| Prerequisite | Matrices, Fourier Transforms, Laplace Transforms | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Perform and evaluate Matrix Operations | **K3** |
| | **CO2** Solve Differential and Integral Equations | **K3** |
| | **CO3** Construct Fourier series and Fourier Transforms of the given function | **K3** |
| | **CO4** Find the Measures of Central tendency | **K3** |
| | **CO5** Analyze Correlation and Regression lines | **K3** |

**List of Experiments:**

1. Find the Inverse, Rank, Eigen values and Eigen Vectors of the matrix.
2. Solve the first order differential equation.
3. Find the integration of $\int_a^b (x)$ .
4. Find the Fourier series of f(x).
5. Find the Fourier Transform of f(x).
6. Find the Laplace Transform of f(x).
7. Find the Mean, Median and Mode.
8. Construct the Pie and Bar Diagram.
9. Find the Correlation coefficient.
10. Find the Regression lines.

| **Lecture Periods:- Nil** | **Tutorial Periods:- Nil** | **Practical Periods: 30** | **Total Periods :30** |
|---|---|---|---|

**Reference Books**


1. T. Veerarajan, “Engineering Mathematics, Tata McGraw Hill Education (India) Private Limited Chennai 2nd Edition Paperback – 1 January 2018.
2. M.K. Venkataraman, “Engineering Mathematics, The National Publishing Company, Madras, 2016.
3. Dr. A. Singaravelu, “Probability and Statistics”, Meenakshi Agency, Paperback – 1, 2019.


**Web References**

1. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf
2. https://www.nrigroupindia.com/niist/wp-content/uploads/sites/6/2022/02/lab-manual-it406matlab.pdf
3. https://www.studocu.com/row/document/comsats-university-islamabad/signals-and-systems/lab-lab-manual/38332410

**COs/POs/PSOs Mapping**

| **COs** | **Program Outcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 2 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 3 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 4 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 5 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

Dr. L. M. Varalakshmi

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Artificial Intelligence and Data Science** | Programme: **B.Tech** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category : **ES** | | | End Semester Exam Type: **LE** | | | |
| Course Code | **U23ADPC01** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Programming in Python Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to All Branches)

| Prerequisite | NIL | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Describe common Python functionality and features used for data science. | **K2** |
| | **CO2** Query Data Frame structures for cleaning and processing. | **K2** |
| | **CO3** Configure your programming environment | **K3** |
| | **CO4** Experiment the concept using data visualization. | **K3** |
| | **CO5** Analyze real time datasets, | **K3** |

**List of Exercises**

1. Build a python program to implement Fibonacci series.
2. Build a python program to get a range of numbers from user and to separate even numbers and odd numbers respectively.
3. Build a function in Python to check duplicate letters. It must accept a string, i.e., a sentence. The function should return True if the sentence has any word with duplicate letters, else return False.
4. Build a program to perform arithmetic operations using lambda function.
5. Build a Python program that takes a list of numbers as input and returns a new list containing only the even numbers from the input list.
6. Build a python program to create a class called Car with attributes Company, model, and year. Implement a method that returns the age of the car in years.
7. Build a python program to create a base class called Shape that has a method called area which returns the area of the shape (set it to 0 for now). Then, create two derived classes Rectangle and Circle that inherit from the Shape class to calculate the area of derived classes.
8. Build a python program to implement aggregation using Numpy.
9. Build a python program to perform Indexing and Sorting.
10. Build a python program to perform Handling of missing data.
11. Build a python program to perform usage of Pivot table using Titanic datasets
12. Build a python program to perform use of eval () and query ()
13. Build a python program to perform Scatter Plot
14. Build a python program to perform 3D plotting
15. Implement an application to process a real time data.

| **Lecture Periods:** | **Tutorial Periods:** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**


1. Chirag Shah, “A Hands-On Introduction to Data Science”, Cambridge University Press, 2020.
2. Siddhartha Chatterjee, Michal Krystyanczuk, “Python Social Media Analytics”, Packt Publishing, 2017.
3. Jake VanderPlas, “Python Data Science Handbook - Essential Tools for Working with Data”, O’Reily Media Inc, 2016.
4. Zhang.Y, “An Introduction to Python and Computer Programming”, Springer Publications, 2016.
5. Wesley J Chun, “Core Python Programming”, Pearson Education, 2nd Edition, 2006.


**Web References**

1. https://nptel.ac.in/courses/106/106/106106212/
2. https://www.geeksforgeeks.org/data-analysis-visualization-python/
3. https://www.coursera.org/learn/python-data-analysis
4. https://www.python.org/
5. https://www.programiz.com/python-programming



**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 2 | 2 | 1 | 3 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 2 | 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 2 | 3 | 2 |
| 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICPC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Linear and Digital Integrated Circuits Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to ICE & BME Branches)

Prerequisite: Basic Electronics Laboratory

**Course Outcomes**

| | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Design application circuits using IC741. | **K3** |
| **CO2** | Design instrumentation amplifier and filter circuits. | **K3** |
| **CO3** | Design multivibrator circuits using 555 timer IC. | **K3** |
| **CO4** | Design and implement combinational circuits. | **K3** |
| **CO5** | Design and implement sequential circuits. | **K2** |

**PART –A**

1. Design and Testing of Inverting amplifier, Non inverting amplifier and Voltage Follower.
2. Design and Testing of Summer and Subtractor circuits.
3. Design and Testing of Differentiator and Integrator.
4. Design and Testing of Instrumentation amplifier
5. Design and Testing of First order active filters (LPF, HPF).
6. Design and Testing of Astable and monostable multivibrators using 555 Timer.

**PART –B**

Study of Logic Gates.

1. Design and implementation of Adder and Subtractor circuits.
2. Implementation of Code converters.
3. Implementation of Encoder / Decoder / Multiplexer / Demultiplexer
4. Implementation of Flip flops.
5. Design and implementation of counters.
6. Design and implementation of 4-bit shift registers.

| **Lecture Periods:** | **Tutorial Periods:-** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**


1. D Roy Choudhury and Shail Jain, “Linear integrated circuits”, New Age Science Limited, Fourth edition, 2018.
2. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, Fourth Edition, Prentice Hall / Pearson Education, 2015.
3. M. Morris Mano and Michael D. Cilette, Digital Designǁ, Prentice Hall, Fifth Edition,2012
4. Thomas L Floyd, “Digital Fundamentals", Prentice Hall, 11th Edition, 2014.
5. Anand Kumar, Fundamentals of Digital Circuitsǁ, Prentice Hall of India, Pvt Ltd, New Delhi, 4th Edition, 2016.


**Web References**

1. https://www.electronics-lab.com/
2. http://vlabs.iitkgp.ernet.in/be/#
3. https://nptel.ac.in/courses/122/106/122106025/

**COs/POs/PSOs Mapping**

| **COs** | **Program Outcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **1** | 3 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **2** | 3 | 1 | - | 1 | 2 | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **3** | 3 | 1 | - | - | 2 | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **4** | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **5** | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | - | 3 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

Dr. L. M. Varalakshmi

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category: **AEC** | | | *End Semester Exam Type: **LE** | | |
| Course Code | **U23ICC3XX** | Periods/Week | | | Credit | Maximum Marks | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **CERTIFICATION COURSE III** | **0** | **0** | **4** | **-** | **100** | **-** | **100** |

Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 50** | **Total Periods:50** |
|---|---|---|---|

### Evaluation Method

| **Assessment** | **Continuous Assessment Marks (CAM)** | | **Total Marks** |
|---|---|---|---|
| | **Attendance** | **MCQ Test** | |
| **Marks** | 10 | 90 | 100 |



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| Department | **Instrumentation and Control Engineering** | Programme : **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **III** | Course Category: **AEC** | | | *End Semester Exam Type:**LE** | | | |
| Course Code | **U23ICS301** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Skill Enhancement Course I** (Choose anyone of the below three courses) | **-** | **-** | **2** | **-** | **100** | **-** | **100** |

| | | | **BT Mapping Highest Level)** |
|---|---|---|---|
| Course Outcome | **CO1** | Analyze common electronic equipments malfunctions. | **K3** |
| | **CO2** | Utilize testing equipment and diagnostic tools for troubleshooting. | **K3** |
| | **CO3** | Identify errors in measurement systems and apply corrective actions. | **K3** |
| | **CO4** | Gain knowledge in programming Arduino microcontrollers using IDE. | **K3** |
| | **CO5** | Develop skills in designing complex electronic circuits in Arduino. | **K3** |

**Course Content:**

## TROUBLESHOOTING OF ELECTRONIC EQUIPMENTS

1. Fundamental Troubleshooting Procedures.
2. Testing of Active and Passive Components.
3. Testing of Semiconductor Devices.
4. PCB Testing and Soldering Techniques.
5. Regulated Power Supply Troubleshooting.
6. Testing of CRO.
7. Troubleshooting Digital Circuits.
8. Tools and Aids for Servicing and Maintenance.

| **Lecture Periods:** | **Tutorial Periods:** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Textbooks**


1. Shashi Bhushan Sinha ,"Handbook of Repair and Maintenance of Domestic Electronics Appliances", BPB Publications, January 2022.
2. K. Sudeep Singh,"Trouble Shooting & Maintenance of Electronic Equipments",S.K.Kataria & Sons, January 2022.


**Reference Books**


1. Dr R.S. Khandpur,"Troubleshooting Electronic Equipment: Includes Repair and Maintenance, MC Graw Hill, Second Edition,2006.
2. Ronald Quan," Troubleshooting Electronic Circuits: A Guide to Learning Analog Electronics: Debugging and Improving Your DIY Projects and Experiments: A Guide to Learning Analog Electronics Paperback", MC Graw Hill, February 2020.


**Web References**

1. https://www.candorind.com/blog/circuit-board-troubleshooting-techniques/
2. https://www.onlinecomponents.com/en/blogpost/how-to-test-electronic-components-191/
3. https://www.udemy.com/course/learn-to-repair-troubleshoot-electronics/
4. https://maker.pro/blog/basics-of-electronic-systems-troubleshooting-for-engineers
5. https://www.sciencedirect.com/book/9780750662789/practical-troubleshooting-of-electrical-equipment-and-control-circuits



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## CALIBRATION OF MEASURING INSTRUMENTS

1. Parts of the Typical Control Loop
2. Process& Instrument Diagrams (P&ID's).
3. Introduction to Measurement System.
4. Commonly used process control signals.
5. Signal quality terminology (accuracy, linearity, span, etc.)
6. System standards and instrument calibration.
7. Study of measurement errors-zero, span, hysteresis, non-linear, dead-band errors.
8. Sensor/Transducer and Transmitter principles
9. Calibration of low and high Pressure Bourden's Gauges.
10. Principle and operation of Strain gauge Pressure Sensors.
11. Operation and calibration of Differential Pressure Transmitter.
12. Calibration of Temperature Indicators (RTD & Thermocouple).

| Lecture Periods: | Tutorial Periods: | Practical Periods: 30 | Total Periods: 30 |
|---|---|---|---|

**Textbooks**


1. Brunelli, Alessandro. Calibration Handbook of Measuring Instruments. United States, ISA, 2017.
2. Measurement, Instrumentation, and Sensors Handbook: Spatial, Mechanical, Thermal, and Radiation measurement, United States, CRC Press, 2017.
3. Petersons, Oskars. Calibration of Test Systems for Measuring Power Losses of Transformers (Classic Reprint), United States, 1kg Limited, 2018


**Reference Books**


1. Kularatna, Nihal. Digital and analogue instrumentation: testing and measurement. London, Institution of Engineering and Technology, 2003.
2. Lay-Ekuakille, Aimé. Advanced Instrument Engineering: Measurement, Calibration, and Design. United States, IGI Global, 2013.
3. Asadi, Farzin, and Eguchi, Kei. Electronic Measurements: A Practical Approach. Switzerland, Morgan & Claypool Publishers, 2021.
4. Measurement, Instrumentation, and Sensors Handbook, Second Edition: Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement. United Kingdom, Taylor & Francis, 2014.


**Web References**

1. https://as.flukecal.com/literature/articles-and-education/electrical-calibration/video/5790b-measurement-standard-demo
2. https://www-pub.iaea.org/mtcd/publications/pdf/tcs-33_cd_web/hmtl/_pur/content/86.html#:~:text=Electrical%20calibration%20implies%20that%20the,and%20traceable%20to%20international%20standards.
3. https://allometrics.com/benefits-of-electronics-calibration/
4. https://onlinecourses.nptel.ac.in/noc24_ee45/preview
5. https://nvlpubs.nist.gov/nistpubs/Legacy/TN/nbstechnicalnote1179.pdf

## APPLICATION OF ARDUINO

**1. Introduction to IOT**

- Understanding IoT fundamentals
- IOT Architecture and protocols
- Various Platforms for IoT
- Real time Examples of IoT
- Overview of IoT components and IoT Communication Technologies
- Challenges in IOT

**2. Arduino Simulation Environment**

- Arduino Uno Architecture
- Setup the IDE, Writing Arduino Software
- Arduino Libraries



- Basics of Embedded C programming for Arduino
- Interfacing LED, push button

**3. Sensor and Actuators with Arduino**

- Overview of Sensors working
- Analog and Digital Sensors
- Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino
- Interfacing of Actuators with Arduino.
- Interfacing of Relay Switch and Servo Motor with Arduino

| Lecture Periods: | Tutorial Periods: | Practical Periods: 30 | Total Periods: 30 |
|---|---|---|---|

**Textbooks**


1. Banzi, Massimo," Getting Started with Arduino", O'Reilly Media, Germany Incorporated, 2011.
2. Javed, Adeel," Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications", United States, Apress, 2016.
3. Cameron, Neil," Arduino Applied: Comprehensive Projects for Everyday Electronics", Apress, Germany, 2018.


**Reference Books**


1. Bolanakis, Dimosthenis E,"Microcontroller Prototypes with Arduino and a 3D Printer: Learn, Program, Manufacture", United Kingdom, Wiley, 2021.
2. Kurniawan, Agus," Arduino Programming with .NET and Sketch",United States, Apress, 2017.
3. Monk, Simon," Arduino + Android Projects for the Evil Genius: Control Arduino with Your Smartphone or Tablet", Ukraine, McGraw Hill LLC, 2011.
4. Misra, Yogesh," Programming and Interfacing with Arduino", United States, CRC Press, 2021.


**Web References**

1. https://www.mathworks.com/videos/how-to-use-the-arduino-explorer-app-in-matlab-1673332715177.html
2. https://www.youtube.com/playlist?list=PLSVmc7PvXPXL5bjfjL_1NXyVUsYfGwvBa
3. http://nitttrc.edu.in/nptel/courses/video/106105159/L17.html
4. https://www.digimat.in/nptel/courses/video/106105193/L21.html
5. https://trainings.internshala.com/blog/arduino-applications/

## Evaluation Method

| Assessment | Continuous Assessment Marks (CAM) | | | Total Marks |
|---|---|---|---|---|
| | Attendance | Report | Presentation / Demo / Skill Test | |
| Marks | 10 | 40 | 50 | 100 |

| Department | Instrumentation and Control Engineering | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | III | Course Category: **MC** | | | *End Semester Exam Type:- | | | |
| Course Code | U23ICM303 | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Climate Change** | **2** | **0** | **0** | **-** | **100** | **-** | **100** |

| UNIT- I | Atmosphere and its Components | Periods:6 |
|---|---|---|

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Importance of Atmosphere-Physical Chemical Characteristics of Atmosphere- Vertical structure of the atmosphere-Composition of the atmosphere-Atmospheric stability-Temperature profile of the atmosphere-Lapse rates-Temperature inversion-effects of inversion on pollution dispersion.

| UNIT- II | Global Climate | Periods:6 |
|---|---|---|

Account of past climate Environmental indicators and instrumental records Human Footprints on global warming- Predicting future climates- Temperature regime - Extreme climate events

| UNIT- III | Impacts of Climate Change | Periods:6 |
|---|---|---|

Causes of Climate change: Change of Temperature in the environment-Melting of ice Pole-sea level rise-Impacts of Climate Change on various sectors Agriculture, Forestry and Ecosystem - Water Resources Human Health Industry, Settlement and Society Methods and Scenarios - Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change - Risk of Irreversible Changes.

| UNIT- IV | Observed Changes and its Causes | Periods:6 |
|---|---|---|

Climate change and Carbon credits- Initiatives in India-Kyoto Protocol-Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks-The Montreal Protocol UNFCCC - IPCC Evidences of Changes in Climate and Environment on a Global Scale and in India.

| UNIT-V | Climate Change and Mitigation Measures | Periods:6 |
|---|---|---|

Clean Development Mechanism -Carbon Trading- examples of future Clean Technology - Biodiesel Natural Compost Eco Friendly Plastic Alternate Energy Hydrogen Bio-fuels-Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices-Carbon sequestration - Carbon capture and storage (CCS) - International and Regional cooperation- Remedial measures.

| Lecture Periods:- | Tutorial Periods: - | Practical Periods:30 | Total Periods:30 |
|---|---|---|---|

**Textbooks**


1. Joan Fitzgerald "Greenovation: Urban Leadership on Climate Change, Oxford University Press 2020.
2. J. David Neelin" Climate change and climate modelling" Cambridge University press (2011).
3. Robin Moilveen "Fundamentals of weather and climate" Oxford University Press (2nd Edition) (2010),
4. Andrew Dessler and Edward A. Parson "The Science and Politics of Global Climate Change" 2009
5. Dash Sushil Kumar, "Climate Change An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.


**Reference Books**


1. Bill McKibben (2012), The Global Warming Reader: A Century of Writing About Climate Change,Penguin.
2. Jason Smerdon(2009) Climate Change: The Science of Global Warming and Our Energy Future, Columbia University
3. Adaptation (2006) and mitigation of climate change-Scientific Technical Analysis. Cambridge University Press, Cambridge.
4. J.M. Wallace and P.V. Hobbs (2006) Atmospheric Science, Elsevier / Academic Press.
5. Jan C. van Dam, (2003) Impacts of "Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press,.


**Web References**

1. https://nptel.ac.in/courses/105102089/
2. https://www.warmheartworldwide
3. https://nptel.ac.in/content/storage

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | Total Marks |
|---|---|---|---|---|
| | Attendance | MCQ Test | Presentation / Activity / Assignment | |
| Marks | 10 | 30 | 60 | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Department | **Mathematics** | | | Programme :**B.Tech.** | | | | | |
| Semester | **IV** | | | Course Category Code: **BS** | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23MATC04** | | | Periods/Week | | | Credit | Maximum Marks | |
| | | | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Numerical Methods and Optimization** | | | **3** | **1** | **0** | **4** | **25** | **75** | **100** |
| (Common to EEE, ECE, ICE, BME, MECH, CIVIL & MECHATRONICS) | | | | | | | | | | |
| Prerequisite | Basic Mathematics | | | | | | | | | |
| **Course Outcomes** | **On completion of the course, *t*he students will be able to** | | | | | | | | BT Mapping (Highest Level) | |
| | **CO1** | Solve Algebraic and Transcendental equations | | | | | | | **K3** | |
| | **CO2** | Solve Simultaneous Equations by various Numerical Techniques. | | | | | | | **K3** | |
| | **CO3** | Apply the Numerical Techniques of interpolation in various Intervals. | | | | | | | **K3** | |
| | **CO4** | Solve Linear programming problems by using Optimization Techniques. | | | | | | | **K3** | |
| | **CO5** | Find the solution of Transportation and Assignment Problems. | | | | | | | **K3** | |
| **UNIT – I** | **Solution of Algebraic and Transcendental Equations and Eigen Value Problems** | | | | | | **Periods:12** | | | |
| Solution of Algebraic and Transcendental equations – Bisection method - Method of False position – Newton Raphson method – Eigen value and Eigen vector by Power method. | | | | | | | | | | **CO1** |
| **UNIT – II** | **Linear Simultaneous Equations** | | | | | | **Periods:12** | | | |
| Solutions of Linear simultaneous equations and Matrix Inversion – Gauss Elimination and Gauss - Jordan methods – Iterative methods – Gauss Jacobi – Gauss Seidel. | | | | | | | | | | **CO2** |
| **UNIT – III** | **Interpolation and Solution of Ordinary Differential Equations** | | | | | | **Periods:12** | | | |
| Interpolation by Newton's Forward and Backward Difference formula for equal intervals – Lagrange's method for unequal intervals – Integration by Trapezoidal and Simpson's rules (Single integration only) – Fourth order Runge-Kutta method for solving first order Differential Equations. | | | | | | | | | | **CO3** |
| **UNIT – IV** | **Linear Programming Problems** | | | | | | **Periods:12** | | | |
| Linear Programming Problems – Graphical Method – Simplex Method – Big M method. | | | | | | | | | | **CO4** |
| **UNIT – V** | **Transportation and Assignment Problems** | | | | | | **Periods:12** | | | |
| Transportation Problems – Initial basic feasible solution using North-West Corner rule, Least Cost Method, Vogel's Approximation Method – Optimality in Transportation Problem by Modified Distribution (MODI) Method. Assignment Problems – Solutions of Assignment Problems by Hungarian Method – Unbalanced Assignment Problems. | | | | | | | | | | **CO5** |
| **Lecture Periods:45** | | **Tutorial Periods:15** | | **Practical Periods:-** | | | **Total Periods:60** | | | |

**Text Books**

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand Limited, 2008.
2. R. Panneerselvam "Operations Research" Prentice Hall of India, 2nd Edition,2004.
3. P.K. Gupta, D.S. Hira, "Operations Research", S. Chand, 5th Edition, 2018.

**Reference Books**

1. AtulGoyal, Madhuchanda Rakshit Suchet Kumar, "Numerical Methods", New India publishing Agency, 1st Edition, 2019.
2. Rajesh Kumar Gupta, "Numerical Methods - Fundamental and Applications", Cambridge University Press, 1st Edition, 2019.
3. S.Kalavathy, "Operation Research" ,Vikas Publishing house,4th Edition,2012.
4. Kevin J. Hastings, "Introduction to the Mathematics of Operations Research with Mathematica", Taylor and Francis, 2nd Edition, 2019.
5. T. Veerarajan, "Operations Research", McGraw Hill, 1st Edition, 2018.

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1. https://nptel.ac.in/courses/111106101/
2. https://www.geektonight.com/operation-research-notes-pdf/#.XrXzoP8za00
3. https://freecomputerbooks.com/Numerical-Methods-with-Applications.html
4. https://www.pphmj.com/journals/IJNMA.htm
5. https://nptel.ac.in/courses/106/108/106108056/

* TE Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 2 | 2 | 1 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 2 | 3 | 3 | 3 | 2 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 3 | 3 | 3 | 3 | 2 | - | 1 | - | - | - | - | - | 1 | 1 | 1 | 1 |
| 4 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | 1 | 1 | 1 | 1 |
| 5 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | - | - | - | 1 | 1 | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



| Department | **Computer Science and Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category Code: **ES** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23CSTC03** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Data Structures** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to all Branches)

| Prerequisite | Any Programming Knowledge | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Compute time and space complexity for given problems | **K3** |
| | **CO2** Demonstrate stack, queue and its operation. | **K3** |
| | **CO3** Illustrate the various operations of linked list. | **K3** |
| | **CO4** Use the concepts of tree for various applications. | **K3** |
| | **CO5** Outline the various Tables, Graphs and Sets techniques. | **K3** |

| **UNIT-I** | **BASIC TERMINOLOGIES OF DATA STRUCTURES** | **Periods: 9** | |
|---|---|---|---|
| Introduction: Basic Terminologies – Asymptotic Notations: Complexity analysis. Array and its operations - Searching: Linear Search and Binary Search Techniques. Sorting: Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort. Performance and Comparison among the sorting methods. | | | **CO1** |
| **UNIT-II** | **STACK AND QUEUE OPERATIONS** | **Periods: 9** | |
| Stacks and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque. | | | **CO2** |
| **UNIT-III** | **LINKED LIST OPERATIONS** | **Periods: 9** | |
| Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations. | | | **CO3** |
| **UNIT-IV** | **TREES** | **Periods: 9** | |
| Trees: Basic Tree Terminologies. Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree- Red Black Tree. | | | **CO4** |
| **UNIT-V** | **GRAPHS , TABLES AND SETS** | **Periods: 9** | |
| Graph: Basic Terminologies and Representations – Graph traversal algorithms. Tables: Different types of tables – Hash Table and its operations - Applications. Sets: Representation of Sets- Operations and its applications. | | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. Ellis Horowitz, Sartaj Sahni," Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4th Edition, 2009.

**Reference Books**

1. D.Samanta, "Classic Data Structures", Prentice-Hall of India, Second Edition, 2012.
2. Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in c" . Prentice-Hall of India, Second Edition, 2007.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second. Edition,2006.
4. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Illustrated Edition, Addison-Wesley Publishing Company, 1995.
5. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Addison- Wesley Publishing Company, Illustrated Edition, 1995.

**Web References**

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| **2** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| **3** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| **4** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| **5** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICTC03** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Linear Control Systems** | **2** | **1** | **0** | **3** | **25** | **75** | **100** |

(Common to ICE and Mechatronics)

| Prerequisite | Basic Mathematics, Signals and Systems, Physics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Comprehend the basic concepts on the modelling of control systems. | **K2** |
| | **CO2** Determine the time response analysis of systems. | **K3** |
| | **CO3** Perform the frequency response analysis of control systems. | **K3** |
| | **CO4** Analyze the stability of the system. | **K2** |
| | **CO5** Design the compensation techniques. | **K3** |

| **UNIT – I** | **Mathematical Modeling of Systems** | **Periods:09** |
|---|---|---|
| Types of System - Open Loop Systems, Closed Loop Systems, Basic Elements in Control System - Electrical Analogy of Mechanical and thermal systems -Transfer function - D.C and A.C Servo Motor - Block Diagram Reduction Techniques - Signal Flow Graphs. | | **CO1** |
| **UNIT – II** | **Time Response Analysis** | **Periods:09** |
| Standard Test Signals -Time Response of First and Second Order System, Time Domain- Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants. | | **CO2** |
| **UNIT – III** | **Frequency Response Analysis** | **Periods:09** |
| Sinusoidal Transfer Function- Frequency Domain Specifications - Correlation between Time and Frequency Response – Construction of Bode Plots - Determination of Gain and Phase Margin from Bode Plots - Polar plots - Determination of Phase Margin and Gain margin from Polar plots – Gain Adjustment using polar plots. | | **CO3** |
| **UNIT – IV** | **Stability of Control Systems** | **Periods:09** |
| Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus - Nyquist Stability Criterion. | | **CO4** |
| **UNIT – V** | **Compensator and State Space Analysis** | **Periods:09** |
| Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot - Concepts of state – state Variable and state models – physical, phase and canonical model. | | **CO5** |

| **Lecture Periods: 30** | **Tutorial Periods: 15** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. Nagrath I J and Gopal M, “Control System Engineering”, New Age International Pvt Ltd, 6th edition, 2017
2. Ogata K, “Modern Control Engineering‖, Prentice-Hall of India Pvt Ltd., New Delhi, 5th edition, 2015.
3. Benjamin C Kuo, “Automatic Control Systems ‖”, Prentice Hall India Pvt. Ltd, 9th edition, 2014.

**Reference Books**

1. Norman S Nise, “Control System Engineering” , John Wiley and sons, inc., 7th edition, 2015
2. SmarajithGhosh, “Control Systems Theory and Applications‖”, Pearson Education, Singapore, 6th edition, 2015
3. Richard C. Dorf, Robert H Bishop, “Modern Control Systems‖”, Pearson Education, 12th edition, 2017.
4. Gopal, M., “Control Systems, Principles and Design”, Tata McGraw-Hill Pub. Co., 4th Edition, New Delhi, 2012.
5. Nagoor kani. A., ‘Control System Engineering’, CBS Publishers and Distributors, 2021.

**Web References**

1. https://lecturenotes.in/notes/6579-note-for-control-system-engineering-cse-by-gyana-ranjan-biswal
2. https://www.smartzworld.com/notes/control-systems-pdf-notes-cs.
3. https://easyengineering.net/control-systems-engineering-by-nagoor-kani/
4. https://civildatas.com/download/control-systems-engineering-by-i-j-nagrath
5. https://www3.nd.edu/~pantsakl/Publications/348A-EEHandbook05.pdf.

* TE – Theory Exam, LE – Lab Exam



**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **2** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **3** | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **4** | 3 | - | 1 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| **5** | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | - | 3 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category : **PC** | | | End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICT404** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Microcontroller Based System Design** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | **Digital Logic Circuits** | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Elucidate the architecture and addressing modes of 8-bit microprocessor | **K2** |
| | **CO2** Illustrate the architecture of PIC18F4550 microcontroller | **K2** |
| | **CO3** Ability to write embedded C program for PIC18F4550 microcontroller. | **K3** |
| | **CO4** Gain knowledge about timer and interrupts | **K3** |
| | **CO5** Learn about design of different peripheral using PIC18F4550 | **K3** |

| **UNIT- I** | **REVIEW OF 8085 MICROPROCESSOR** | **Periods:09** | |
|---|---|---|---|
| Evolution of microprocessor, Types of various architectures; Harvard and Von-Neumann, RISC and CISC, 8085 microprocessor- Pin Functions, Architecture, Addressing modes Interrupts, Direct Memory Access, I/O Mapping. | | | **CO1** |
| **UNIT- II** | **ARCHITECTURE OF PIC18F4550 MICROCONTROLLER** | **Periods:09** | |
| PIC microcontrollers overview and features- PIC18F4550 architecture, status register, Special function registers, memory organization, PIC18F4550 pin configuration. | | | **CO2** |
| **UNIT- III** | **PIC18F4550 With Embedded C** | **Periods:09** | |
| MPLAB IDE with compiler, Data Types and Time Delays in C, I/O Programming, Logic Operations, Data Serialization, Program ROM Allocation, Data RAM Allocation, MACROs — Intel HEX file. | | | **CO3** |
| **UNIT- IV** | **TIMER AND INTERRUPTS** | **Periods:09** | |
| GPIO programming, Timers Programming, Counter programming, PWM programming, Serial Communication, Interrupts. | | | **CO4** |
| **UNIT-V** | **PERIPHERAL AND INTERFACING** | **Periods:09** | |
| LCD Interfacing, Keyboard Interfacing, ADC Programming in the PIC18F4550, DAC Interfacing, Relay interfacing, Sensor Interfacing, Stepper Motor Interfacing. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Penram International (P) ltd., Mumbai, 6th edition, 2013.
2. Mazidi M.A., PIC Microcontroller and Embedded Systems: Using assembly and C for PIC, Pearson publishing, 2016.
3. Mark Siegesmund, "Embedded C Programming: Techniques and Applications of C and PIC MCUS", Newnes publisher, 2014.

**Reference Books**

1. Sunil Mathur, Jeebananda Panda, "Microprocessor and microcontroller", PHI Learning Private Limited, New Delhi, 1st Edition, 2016.
2. Peatman J., Embedded system Design using PIC18Fxxx, Prentice Hall, 2013.
3. Peatman J., Design with PIC microcontrollers, Pearson Education, 2010.

**Web References**

1. https://www.youtube.com/watch?v=rSFIUkQYLrk
2. https://www.youtube.com/watch?v=S1QCZW92fU4
3. https://www.youtube.com/watch?v=iecMfsMxCHI
4. https://www.microchip.com/promo/explorer-8-development-board
5. https://pic-microcontroller.com/pic18f4550-programming-and-tutorial-hardware-c/#PIC18F_Microcontroller_Programming_Tutorial

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 2 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 4 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 5 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | |
|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category : **ES** | | | End Semester Exam Type:**TE** | | |
| Course Code | **U23ICB402** | Periods/Week | | | Credit | Maximum Marks | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Solid and Fluid Mechanics** | **2** | **0** | **2** | **3** | **50** | **50** | **100** |

| | | | |
|---|---|---|---|
| Prerequisite | - | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Analyze the state of stress and strain at any point in a member. **(K2)** | **K2** |
| | **CO2** | Evaluate the properties of material Deformation. **(K2)** | **K2** |
| | **CO3** | Apply Hagen Poisueille's equation to solve numerical Problems. **(K3)** | **K3** |
| | **CO4** | Understand the concepts of stress and strain in mechanics of solids and structures and material Properties. **(K3)** | **K2** |
| | **CO5** | Conduct experiments on hydraulic turbines and pumps to draw characteristics. | **K3** |

| | | | |
|---|---|---|---|
| **UNIT- I** | **Deformation of Solids** | **Periods:10** | |
| Concept of stress and strain– stress strain curve – Simple and compound Stresses - Elasticity and elastic moduli – Poisson's ratio – Thin Cylinder. | | | **CO1** |
| **UNIT- II** | **Shafts and Springs** | **Periods:10** | |
| Torsion – Shear stresses in circular solid and hollow shafts -Torque and power – Helical and leaf springs – Load, deflection, stress and stiffness relationships. | | | **CO2** |
| **UNIT- III** | **Fluid Property and Flow Characteristics** | **Periods:10** | |
| Fluid Property - Newton's law of Viscosity – Types of Flow– Reynolds number –Continuity equation - Euler's Equation of Motion. Bernoulli's Equations –Venturi meter and orifice meter - Pressure losses along the flow –Major and minor losses | | | **CO3** |
| **UNIT- IV** | **Part – A: Fluid Mechanics Laboratory** | **Periods:15** | |
| **List of Exercises**<br>1. Determination of Coefficient of discharge of given Venturimeter.<br>2. Determination of Coefficient of discharge of given Orifice meter.<br>3. Characteristics study on Centrifugal Pump.<br>4. Characteristics study on Submergible Pump.<br>5. Characteristic study on turbines. | | | **CO4** |
| **UNIT-V** | **Part – B: Strength of Materials Laboratory** | **Periods:15** | |
| **List of Exercises**<br>1. Tension test and Young's modulus of steel.<br>2. Hardness test: Rockwell and Brinell.<br>3. Torsion test: Rods and Flats.<br>4. Impact test: Charphy and Izod on metals.<br>5. Ductility test: Sheet metals (Al and MS) | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:30** | **Tutorial Periods:-** | **Practical Periods:30** | **Total Periods:60** |

**Text Books**

1. R. K. Rajput, Strength of Materials, S. Chand & Company Ltd., 2018.
2. R.K., Bansal, A text book on Fluid Mechanics & Hydraulic Machinery, M/s. Lakshmi Publications
3. (P) Ltd, 2018.
4. Junarkar S. B, "Mechanics of Structures", Vol. 2, 24th edition, Charotar Publising House, Anand, India, 2015.

**Reference Books**

1. WilliamA.Nash, “Theory and problems of strength of materials”, Schaum’s Outline Series, McGraw-Hill International Editions, Sixth Edition(Paperback), 2013
2. Streeter, V.L., and Wylie, E.B."Fluid Mechanics", McGraw-Hill, Ninth Edition (Paperback), 2017
3. White, F.M.,"Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
4. Som, S.K., and Biswas, G. "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2nd Edition (Paperback), 2010
5. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New Delhi (Reprint edition), 2010.
6. R.S.Khurmi, Strength of Materials, S.Chand& company, 24thEdition, 2006

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1. https://link.springer.com/chapter/10.1007/978-3-319-46407-7_1
2. https://nptel.ac.in/courses/105/103/105103095/
3. https://nptel.ac.in/courses/103/104/103104043/
4. https://www.iitk.ac.in/me/fluid-mechanics-laboratory
5. https://fm-nitk.vlabs.ac.in/
6. https://rc.library.uta.edu/uta-ir/bitstream/handle/10106/28623/Applied-Fluid-Mechanics-Lab-Manual-1565646222.pdf?sequence=1&isAllowed=y

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | 2 |
| 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | 2 |
| 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | 2 |
| 4 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | 2 |
| 5 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | - | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

## Assessment method for theory cum practical course

| Assessment | Continuous Assessment Marks (CAM) – Maximum 50 Marks | | | | | | | | | End Semester Examination (ESE) Marks (Theory) | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continuous Assessment (Theory) | | | | | Continuous Assessment (Practical) | | | | | |
| | CAT 1 | CAT 2 | Model | Attendance | Total | Conduction of Practical | Report | Viva | Total | #End Semester Examination (ESE) Marks (Practical – Internal Evaluation) | |
| Marks | 5 | 5 | 5 | 5 | 20 * | 15 | 10 | 5 | 30* | | 75** | - |
| *To be weighted for 10 Marks | | | | | 10 | *To be weighted for 10 Marks | | | 10 | 30 | **To be weighted for 50 Marks | 100 |

# Final End Semester practical exam to be conducted with internal and external examiner by Head of the institution and HoD.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **English** | Programme: **B.Tech.** | | | | | | |
| Semester | **IV** | Course Category Code: **HS** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ENPC02** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **General Proficiency- II** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to ALL Branches except CSBS)

| | | | |
|---|---|---|---|
| Prerequisite | Basics of English Language | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Infer ideas to attend international standardized test by broadening receptive and productive skills | **K2** |
| | **CO2** | Interpret the types of writing in different state of affairs | **K3** |
| | **CO3** | Acquire meticulous exposure in speaking and get rid of performance anxiety | **K2** |
| | **CO4** | Articulate the ideas and opinions effectively and coherently | **K2** |
| | **CO5** | Progress the skills to compete in various competitive exams like GATE, GRE, UPSC, etc. | **K4** |

| | | | |
|---|---|---|---|
| **UNIT- I** | **CAREER SKILLS** | **Periods:6** | |
| Listening: Listening at specific contexts - Speaking: Demonstrative speaking practice using visual aids (charts, graphs, maps) - Reading: Read and Review -Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) - Writing: Integrated Writing Task (TOEFL) - Vocabulary: Synonyms and Antonyms (IELTS) | | | **CO1** |
| **UNIT- II** | **CORPORATE SKILLS** | **Periods:6** | |
| Listening: Listening English news and reproducing in own words - Speaking: Team Presentation - Reading: Short texts and Longer Passages (cloze reading) - Writing: Analytical Writing: Analyzing an issue and Argument task (GRE based) - Vocabulary: Prefix and Suffix | | | **CO2** |
| **UNIT- III** | **FUNCTIONAL SKILLS** | **Periods:6** | |
| Listening: Listening TED Talks - Speaking: Brainstorming & Individual Presentation - Reading: Text Completion (GRE Based) - Writing: Picture Inference - Vocabulary: Word Formation | | | **CO3** |
| **UNIT- IV** | **TRANSFERRABLE SKILLS** | **Periods:6** | |
| Listening: Listening Documentaries and making notes - Speaking: Mock Interview - Reading: Read texts on emerging trends - Writing: Agreeing & Disagreeing Essay (IELTS) - Vocabulary: Euphemism, Redundancy, Clichés and Intensifiers | | | **CO4** |
| **UNIT-V** | **VERBAL APTITUDE - II** | **Periods:6** | |
| **Transformational Grammar:** Tenses, Change of Voice, Concord<br>**Verbal Ability Enhancement:** Letter Series, Coding &Decoding, Sentence Equivalence (GRE)Analytical Reasoning and Logical Reasoning (GATE), Syllogism, One-word Substitution, Jumbled Sentences | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods:30** | **Total Periods:30** |

**Reference Books**

1. Cullen, Pauline, Amanda French, and Vanessa Jakeman. "The official Cambridge guide to IELTS for academic & general training". Cambridge, 2014.
2. Prasad, Hari Mohan, Sinha, Uma Rani, "Objective English for Competitive Examinations", Tata Mc Graw Hill: Noida,2010.
3. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008.
4. Grussendorf, Marion, "English for Presentations", Oxford University Press, Oxford, 2007.
5. Murphy, Raymond English Grammar in Use with answers: Reference and Practice for Intermediate students, Cambridge: CUP,2004.

**Web References**

1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 2 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 3 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 4 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |
| 5 | 1 | - | - | - | - | - | - | - | - | 3 | - | 2 | 1 | 1 | 1 |

Correlation Level: 1-Low, 2-Medium, 3-High

**Evaluation Methods**

| Practical | | | | |
|---|---|---|---|---|
| **Continuous Assessment Internal Evaluation** | | **End Semester External Evaluation** | | **Total Marks** |
| **50 marks** | | **50 marks** | | 100 |
| Conduction of Practical<br>(Assignment 1&2 -10 Marks<br>Performance in practical classes - 5 Marks) | 15 | Listening (L) | 20 | |
| Record | 5 | Speaking(S) | 10 | |
| Viva | 5 | Reading(R) | 10 | |
| Model Practical Examination<br>(Model Exam is conducted for 50 Marks that will be converted to 15 Marks) | 15 | Writing(W) | 10 | |
| Attendance | 10 | | | |

| Department | **COMPUTER SCIENCE AND ENGINEERING** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category Code: **ES** | | | | *End Semester Exam Type: **LE** | | |
| Course Code | **U23CSPC02** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Data Structures Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

(Common to all Branches)

| Prerequisite | Basic Programming Knowledge | |
|---|---|---|
| **Course Outcome** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Analyse the algorithm's / program's efficiency in terms of time and space complexity. | **K3** |
| | **CO2** Solve the given problem by identifying the appropriate Data Structure. | **K3** |
| | **CO3** Solve the problems of searching and sorting techniques. | **K3** |
| | **CO4** Solve problems in linear Data Structures. | **K4** |
| | **CO5** Solve problems in non-linear Data Structures. | **K4** |

**List of Experiments:**

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list. a) Delete an element from list b) Search for a key element in list c) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder b) Inorder c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.
11. Write a C program to implement the Set operations.
    a) Union b) Intersection c) Difference.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**

1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd Edition, 2019.
2. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st Edition, 2019.
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st Edition, 2017.
4. Reema Thareja, "Data structures using C", Oxford University, 2nd Edition, 2014.
5. Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st Edition, 2013.

**Web References**

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. https://nptel.ac.in/courses/106103069/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 2 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 3 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 5 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

Academic Curriculum 2020 (R 2020)

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **PC** | | | End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP404** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Microcontroller Based System Design Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

| Prerequisite | Digital circuit Laboratory | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Gain conceptual understanding of using 8085 microprocessor | **K2** |
| | **CO2** Learn about interfacing of various peripheral devices with PIC18F4550 Microcontrollers | **K2** |
| | **CO3** Analyze the programming aspects of PIC microcontroller | **K3** |
| | **CO4** Design and develop PWM for real time applications. | **K3** |
| | **CO5** Design and simulate microcontroller based systems used for control and monitoring | **K3** |

**List of Experiments**

1. Study of 8085 microprocessor Programming
2. Implementation of GPIO of PIC18F4550.
3. Relay interfacing using PIC microcontroller
4. Implementation of UART features of PIC microcontroller.
5. Interfacing of 7 Segment display with PIC microcontroller.
6. LCD interfacing using PIC microcontroller.
7. Implementation of ADC of PIC microcontroller.
8. Generation of square waveform of given duty cycle using PIC microcontroller.
9. Stepper motor interfacing using PIC microcontroller.
10. DC motor speed control using PIC microcontroller.

| **Lecture Periods:** | **Tutorial Periods:-** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**


1. Ajay V Deshmukh, “Microcontrollers: Theory and Applications”, Tata McGraw-Hill, 2005.
2. Andrew N. Sloss Dominic Symes and Chris Wright, “ARM System Developer’s Guide Designing and Optimizing System Software”, Morgan Kaughmann/Elsevier Publishers, 2006.
3. Mazidi M.A., PIC Microcontroller and Embedded Systems: Using assembly and C for PIC, 2008.
4. Peatman J., Embedded system Design using PIC18Fxxx, Prentice Hall, 2003.
5. Peatman J., Design with PIC microcontrollers, Pearson Education, 2006.


**Web References**

1. https://www.mikroe.com/easymx-pro-stm32
2. https://ww1.microchip.com/downloads/aemDocuments/documents/OTH/ProductDocuments/DataSheets/39632e.pdf.
3. https://microcontrollerslab.com/introduction-pic18f4550-microcontroller/
4. https://www.youtube.com/watch?v=MtxKP81Dy1E
5. https://www.microchip.com https://www.youtube.com/watch?v=S1QCZW92fU4

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | - | 2 | - | 3 | - | 2 | - | - | - | - | - | 2 | 2 | 1 |
| 2 | 3 | - | 3 | - | 3 | - | 2 | - | - | - | - | - | 3 | 2 | 1 |
| 3 | 3 | - | 3 | -- | 3 | - | 2 | - | 2 | - | - | - | 3 | 2 | 1 |
| 4 | 2 | - | 3 | - | 3 | - | 2 | - | - | - | - | - | 2 | 2 | 1 |
| 5 | 3 | 2 | 3 | - | 3 | - | 2 | - | - | - | - | - | 2 | 2 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP405** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Simulation Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

| Prerequisite | Basics of Mathematics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Gain adequate knowledge on the basics of control system tools. | **K2** |
| | **CO2** Obtain the model of the system and investigate its performance in open and closed loop. | **K3** |
| | **CO3** Determine the time response analysis of first and second order systems. | **K4** |
| | **CO4** Obtain the system stability in time domain and frequency domain. | **K4** |
| | **CO5** Understand the effect of PI and PD controller. | **K3** |

**List of Experiments**

1. Determination of (i) Transfer Functions and (ii) Poles and Zeros of the system.
2. Determination of Step, Impulse and Ramp Response for a First and Second Order Unity Feedback System
3. Stability analysis of Linear Systems.
4. Compensation of Closed Loop System.
5. Frequency Response analysis using Bode Plot.
6. Frequency Response analysis using Nyquist Plot.
7. Frequency Response analysis using Root Locus Plot.
8. Time domain Analysis using Simulink blocks.
9. Effect of PI and PD controller on system performance.
10. Effect of Addition of Poles to the Forward Path Transfer Function of a Closed Loop System.

| **Lecture Periods:** | **Tutorial Periods:-** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Reference Books**

1. Nagrath I J and Gopal M, Control System Engineering, New Age International Pvt Ltd, Sixth Edition, 2017.
2. DingyüXue, YangQuan Chen, Modeling, Analysis and Design of Control Systems in MATLAB and Simulink, World Scientific Publishing,2014
3. Liuping Wang, PID Control System Design and Automatic Tuning Using MATLAB/Simulink, Wiley, 2020
4. Norman S Nise, Control System Engineering , John Wiley and sons, inc., Seventh Edition, 2015
5. SmarajithGhosh, —Control Systems Theory and Applicationsǁ, Pearson Education, Singapore, Sixth Edition, 2015.

**Web References**

1. https://in.mathworks.com/products/matlab.html
2. https://nptel.ac.in/courses/108108122/
3. https://www.smartzworld.com/notes/control-systems-pdf-notes-cs/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 3 | 3 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 2 | 3 | 1 | 3 | 3 | 3 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 3 | 3 | - | - | 3 | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 |
| 4 | 3 | - | - | 3 | 2 | - | - | - | - | - | - | - | 2 | 3 | 3 |
| 5 | 3 | - | - | 3 | 2 | - | - | - | - | - | - | - | 2 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**



**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |



| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **AEC** | | | | *End Semester Exam Type:**LE** | | |
| Course Code | **U23ICC4XX** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Certification Course – IV** | **0** | **0** | **4** | **-** | **100** | **-** | **100** |

Students shall choose an international certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

| **Lecture Periods:-** | **Tutorial Periods: -** | **Practical Periods: 50** | **Total Periods:50** |
|---|---|---|---|

## Evaluation Method

| **Assessment** | **Continuous Assessment Marks (CAM)** | | **Total Marks** |
|---|---|---|---|
| | **Attendance** | **MCQ Test** | |
| Marks | 10 | 90 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **AEC** | | | | *End Semester Exam Type: - | | |
| Course Code | **U23ICS402** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Skill Enhancement Course II** (Choose anyone of the below three courses) | **0** | **0** | **2** | **-** | **100** | **-** | **100** |
| Prerequisite | | | | | | | | |

| Course Outcomes | **On completion of the course, the students will be able to** | **BT Mapping (Highest Level)** |
|---|---|---|
| | **CO1** Comprehend basic Concepts of Raspberry Pi. | **K2** |
| | **CO2** Understand Cloud and Sensor Networks. | **K3** |
| | **CO3** Perform different types of PLC Programming. | **K2** |
| | **CO4** Implement Ladder diagrams for process control applications. | **K3** |
| | **CO5** Develop skills in creating and drafting P&IDs using industry-standard software tools | **K2** |

**Course Content:**

## APPLICATIONS USING RASPBERRY PI

1. Blink an LED to learn GPIO basics.
2. Respond to button presses for input-output practice.
3. Read temperature with a sensor and display the value.
4. Measure distance using an ultrasonic sensor.
5. Control a servo motor for precise movement.
6. Drive a stepper motor in specific steps.
7. Display messages and graphics on an LCD screen.
8. Create simple sounds or alarms with a buzzer.
9. Set up a web server using Python to build web apps.
10. Log sensor data over time for data collection and analysis.
11. Monitor network traffic to troubleshoot potential issues.
12. Control your Raspberry Pi remotely with SSH or VNC.
13. Build a simple home automation system to control devices.
14. Create your own games using libraries like Pygame.
15. Connect your Pi to the internet and explore the world of IoT.

| **Lecture Periods:** | **Tutorial Periods:** | **Practical Periods: 30** | **Total Periods:30** |
|---|---|---|---|

**Reference Books**

1. Ajay V Deshmukh, “Microcontrollers: Theory and Applications”, Tata McGraw-Hill, 2005.
2. Andrew N. Sloss Dominic Symes and Chris Wright, “ARM System Developer’s Guide Designing and Optimizing System Software”, Morgan Kaughmann/Elsevier Publishers, 2006.
3. Mazidi M.A., PIC Microcontroller and Embedded Systems: Using assembly and C for PIC, 2008.
4. Peatman J., Embedded system Design using PIC18Fxxx, Prentice Hall, 2003.
Peatman J., Design with PIC microcontrollers, Pearson Education, 2006.

**Web References**

1. https://www.mikroe.com/easymx-pro-stm32
2. https://ww1.microchip.com/downloads/aemDocuments/documents/OTH/ProductDocuments/DataSheets/39632e.p df.
3. https://microcontrollerslab.com/introduction-pic18f4550-microcontroller/
4. https://www.youtube.com/watch?v=MtxKP81Dy1E
5. https://www.microchip.com https://www.youtube.com/watch?v=S1QCZW92fU4

## PLC PROGRAMMING

1. Identify various parts and front panel status indicators of the given PLC.
2. Use PLC to test the START STOP logic for two inputs and one output.
3. Develop /Execute a ladder program for the given application using following:- timer, counter, comparison, logical, arithmetic instruction.
4. Measure temperature of the given liquid using RTD or Thermocouple and PLC.
5. Develop/ test ladder program to blink LED/lamp.
6. Develop/ test ladder program for sequential control application of lamps/ DC motors.
7. Develop/ test ladder program for traffic light control system.
8. Develop/ test ladder program for pulse counting using limit switch/proximity sensor.
9. Develop/ test ladder program for automated car parking system.
10. Develop/ test ladder program for automated elevator control.
11. Implementation of logical function using PLC programming
12. Implementation of Timer and counter for a given applications using PLC programming
13. Development of GUI for a typical plant.
14. Development of an alarm, and historian system for a typical process.

| Lecture Periods: | Tutorial Periods: | Practical Periods: 30 | Total Periods:30 |
|---|---|---|---|

**Reference Books**

1. McMillan, G. K., “Process Industrial Instrument and controls handbook”, McGraw Hill, Newyork, 1999.
2. Berge.J., “Field buses for process control: Engineering, operation and maintenance”, ISA Press, 2004.
3. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP 3”, Summit Valley Press; 2nd Edition, 2014.
4. Mikel P. Grover, et. Al. “Industrial Robots – Technology Programming and Applications”, McGraw Hill, 1980.
5. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw-Hill, 2004.

**Web References**

1. https://nptel.ac.in/courses/108105063/
2. https://www.google.com/amp/s/controlstation.com/what-is-a-distributed-control-system/amp/
3. https://nptel.ac.in/courses/108/105/108105088/
4. https://onlinecourses.nptel.ac.in/noc20_me39/preview
5. https://nptel.ac.in/content/syllabus_pdf/108105088.pdf.

**AUTOCAD FOR INSTRUMENTATION**

1. Fundamentals of instrumentation and control engineering
2. Simple and complex loop drawing
3. Preparing isometrics & instrumentation hook-ups
4. Instrument cable tray & routing diagram
5. Instrument nozzle elevation drawing
6. Control valve assembly
7. Field wiring diagrams
8. Level sketches
9. JB & MR layouts
10. Cable tray & cable routing
11. Piping & instrumentation diagram
12. Plot plan, key plan & section plan
13. Plant location layout
14. Control room layout
15. Instrument air routing diagram

| Lecture Periods: | Tutorial Periods: | Practical Periods: 30 | Total Periods:30 |
|---|---|---|---|

**Reference Books**

1. Autodesk AutoCAD Certified User Study Guide AutoCAD 2025 Edition By Daniel John Stine AIA, IES, CSI, CDT, Well AP, William G. Wyatt Ed. D., CET, December 2024.
2. Engineering Graphics Essentials with AutoCAD 2025 Instruction by Kirstie Plantenberg, July 3, 2024.

**Web References**

1. https://www.bricsys.com/en-in/bricscad?utm_term=autocad&utm_campaign=Google+.+Search+.+Competitors+.+APAC+-+IN+.+English&utm_source=Google&utm_medium=CPC&hsa_acc=9137038195&hsa_cam=20542660219&hsa_grp=152730513345&hsa_ad=690662425149&hsa_src=g&hsa_tgt=kwd-10196511&hsa_kw=autocad&hsa_mt=b&hsa_net=adwords&hsa_ver=3&gad_source=1&gclid=CjwKCAjw6c63BhAiEiwAF0EH1Mk_A_M2Vt62XKyri1MiZ14BnLstd6A8RHTyHW4Z2Kj_S55uCR1kghoC8zQQAvD_BwE
2. https://www.smartdraw.com/cad/piping-and-instrumentation-diagram-software.htm
3. https://www.edrawsoft.com/what-is-piping-instrumentation-diagram.html
4. https://online.visual-paradigm.com/de/knowledge/engineering/p-and-id-diagram/
5. https://www.sydle.com/blog/p-id-64ef8c5d2ecc0b101ec075c1

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | Total Marks |
|---|---|---|---|---|
| | Attendance | Report | Presentation / Demo / Skill Test | |
| Marks | 10 | 40 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **MC** | | | *End Semester Exam Type:- | | | |
| Course Code | **U23ICM404** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Right to Information and Good Governance** | **2** | **0** | **0** | **-** | **100** | **-** | **100** |

| **UNIT- I** | **Introduction** | **Periods:6** |
|---|---|---|

Conceptual background - Right to know - Open Government - Transparency in governance and accountability - Right to information under the Indian Constitution - Article 19 (1)(a) and Article 21 of the Constitution - Role of NGOs and movement for right to information - Right to Information Act, 2005 - Scope and objectives.

| **UNIT- II** | **Obligation of Public Authorities** | **Periods:6** |
|---|---|---|

Obligations of public authorities: Section 4
Designation of Public Information Officers: Section 5
Disposal of request: Section 7
Exemption from disclosure of information: Section 8
Grounds for rejection to access in certain cases: Section 9
Severability: Section 10
Third party information: Section 11

| **UNIT- III** | **Central and State Information Commission** | **Periods:6** |
|---|---|---|

Constitution of Central and State Information Commissions
Terms of office and conditions of service
Removal of Chief Information Commissioner or Information Commissioner.
Powers and functions of Information Commissions.

| **UNIT- IV** | **Judiciary and Right to Information Act** | **Periods:6** |
|---|---|---|

Protection of right to access the information - Role of the Supreme Court and High Courts Recent attempts of dilution of the right to information Law

| **UNIT-V** | **Right to Information Act, 2005 and its relevance to other laws** | **Periods:6** |
|---|---|---|

Public Records Act, 1993
Whistle Blowers Protection Act, 2014
Official Secrets Act, 1923

| **Lecture Periods: 30** | **Tutorial Periods:** | **Practical Periods:** | **Total Periods:30** |
|---|---|---|---|

**Evaluation Method**

| **Assessment** | **Continuous Assessment Marks (CAM)** | | | **Total Marks** |
|---|---|---|---|---|
| | **Attendance** | **MCQ Test** | **Presentation / Activity / Assignment** | |
| Marks | 10 | 30 | 60 | 100 |

| Department | **Management Studies** | Programme: **B.Tech** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **HS** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23HSTC02** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Research Methodology** | **2** | **0** | **0** | **2** | **25** | **75** | **100** |

**Common to ALL Branches**

| Prerequisite | **Nil** | |
|---|---|---|
| **Course Outcomes** | ***On completion of the course, the students will be able to*** | **BT Mapping (Highest Level)** |
| | **CO1** Interpret the different types of research and explain how research methods can be used to address engineering problems. | **K2** |
| | **CO2** Discuss the research problems, conduct comprehensive literature reviews, and utilize tools and services for effective information retrieval. | **K2** |
| | **CO3** Apply appropriate methods to design experiments, analyze data, and interpret results using both numerical and graphical techniques. | **K3** |
| | **CO4** Analyze and apply ethical guidelines to structure and write research papers and dissertations, ensuring academic integrity and avoiding plagiarism. | **K4** |
| | **CO5** Examine the fundamentals of intellectual property rights to protect and enforce them, with emphasis on their role in fostering innovation and entrepreneurship in engineering. | **K3** |

| **UNIT-I** | **Introduction to Research** | **Periods: 6** |
|---|---|---|
| Meaning and Importance of Research, Types of Research: Overview of Basic, Applied, and Developmental Research, Overview of the Research Process, Defining a Research Problem: Key Considerations, Setting Research Objectives and Research Questions, Introduction to Research Design: Basic Concepts, Approaches to Research: Quantitative vs. Qualitative. | | **CO1** |
| **UNIT-II** | **Problem Formulation and Literature Review** | **Periods: 6** |
| Identifying and Formulating Research Problems, conducting a Literature Review: Essential Steps, Referencing and Citation Methods: Basic Techniques. Sources of Information: Overview of Libraries and Online Databases. | | **CO2** |
| **UNIT-III** | **Research Methods and Data Analysis** | **Periods: 6** |
| Introduction to Experimental Research, Developing Hypotheses: Basic Approach. Data Collection Methods: Sampling and Surveys, Basics of Data Analysis: Numerical and Graphical Analysis, Introduction to Inferential Statistics. | | **CO3** |
| **UNIT-IV** | **Writing and Presenting Research** | **Periods: 6** |
| Preparing a Research Report: Key Sections (Abstract, Introduction, Methodology, Results, Discussion, Conclusion). Referencing and Citation: Brief Overview. | | **CO4** |
| **UNIT-V** | **Ethics and Intellectual Property in Research** | **Periods: 6** |
| Ethical Considerations in Research: Introduction to Scientific Misconduct. Basics of Intellectual Property Rights - Introduction to Patents, Copyrights, and Trademarks – Case studies on ethical dilemmas in research. | | **CO5** |

| **Lecture Periods: 30** | **Tutorial Periods:** | **Practical Periods:** | **Total Periods: 30** |
|---|---|---|---|

**Text Books**

1. Kumar, R. Research Methodology: A Step-by-Step Guide for Beginners, 5th Edition, SAGE Publications, 2019.
2. Ram Ahuja, *Research methods*, Rawat Publications, 2nd edition, 2022
3. Creswell, J. W., and Creswell, J. D. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th Edition, SAGE Publications, 2018.

**Reference Books**

1. Thiel DV. Research methods for engineers. Cambridge: Cambridge University Press; 2014.
2. Ganesan R. Research methodology for engineers. Chennai: MJP Publishers; 2024.
3. Agarwal C, Sharma V. Research methodology in sociology. New Delhi: Commonwealth Publishers; 2012.
4. Thody A. Writing and presenting research. 2nd edition, London: SAGE Publications; 2006.
5. Kothari CR. Research methodology – methods and techniques. 5th edition, New Delhi: New Age International Publishers; 2023.

**Web References**

1. https://conjointly.com/kb/
2. https://owl.purdue.edu/owl/research_and_citation/conducting_research/writing_a_literature_review.html



3. https://files.eric.ed.gov/fulltext/ED536788.pdf
4. https://researcheracademy.elsevier.com/
5. https://www.wipo.int/
6. https://www.scholastic.com /7-steps-to-successful-research-report.html
7. https://www.futurelearn.com/info/courses/business-research-methods- investigation.
8. https://articles.manupatra.com/article-details/Patent-Types-Laws-related-to-them-in-India

**COs/POs/PSOs Mapping**

| Course Outcomes (COs) | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | PSO1 | PSO2 | PSO3 |
| **CO1** | 3 | 3 | 2 | 2 | 2 | - | 2 | - | - | 2 | 2 | 3 | - | 1 | 1 |
| **CO2** | 3 | 1 | 1 | 3 | 1 | - | 2 | - | - | 1 | 2 | - | - | 1 | 1 |
| **CO3** | 1 | 3 | 3 | 1 | 3 | - | 2 | - | - | 2 | 2 | - | - | 1 | 1 |
| **CO4** | - | - | 1 | 2 | - | - | 2 | 3 | 2 | 2 | - | 2 | - | 1 | 1 |
| **CO5** | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | - | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



| Department | **Information Technology** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **ES** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23ITTC02** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Programming in Java** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to All Branches)

| | | |
|---|---|---|
| Prerequisite | Basic knowledge of Object-Oriented Programming Principles | |
| **Course Outcome** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Articulate the concept of Java fundamentals, OOPs and Strings | **K2** |
| | **CO2** Demonstrate the principles of inheritance, packages and interfaces with real time applications | **K2** |
| | **CO3** Create real time applications using exception handling and thread programming. | **K3** |
| | **CO4** Build distributed applications using Collections and IO streams | **K3** |
| | **CO5** Design and build simple GUI programs using AWT, Swings and build database applications | **K3** |

| **Unit- I** | **Introduction** | **Periods:09** |
|---|---|---|
| **Introduction**: Java: History – Features – JVM - JRE – JDK – Java Compilation and Execution – Data Types - Variables, Types, Expressions, Assignment Statements, Input / Output Statements: Scanner/System class, Type Casting(Primitives to Primitives), Conditional and Iterative Control Structures - Arrays<br>**OOPs with Java:** Introduction to OOPs Concepts - Class – Objects – Methods - Access Modifiers – Creating Class and Objects, Object Life-Cycle - Garbage Collection-Constructors - this – static – Array of Objects – Nested Classes.<br>**String**: String Class– Built-in Methods – String Builder – String Buffer | | **CO1** |
| **Unit- II** | **Inheritance, Interfaces and Packages** | **Periods:09** |
| **Inheritance:** Types of Inheritance – is-a Relationship, has-a Relationship – super keyword – final keyword – Polymorphism - Method overloading and Method overriding – Abstract Class<br>**Interfaces:** Define – Extend – Implement – Access - Interfaces vs Abstract classes, Type Conversions (Primitives to Objects vice-versa): Autoboxing and Auto unboxing<br>**Packages:** Define – Create – Access – Import | | **CO2** |
| **Unit- III** | **Exception Handling and Multithreading** | **Periods:09** |
| **Exception Handling:** Exception Hierarchy – Checked and Unchecked Exceptions – try, catch, throws, throw and finally – User Defined Exceptions.<br>**Multithreading:** Thread – Life cycle – Defining and Running – Implementation Types – Thread Priorities – Thread Synchronization - Inter-Thread Communication | | **CO3** |
| **Unit- IV** | **Collections and I/O Streams** | **Periods:09** |
| **Collections:** List: Array List and Linked List. Set: Hash Set and Tree Set. Map: Hash Map – Stack – Queue. Lambda Expressions.<br>**I/O Streams:** Streams – Byte Streams and Character Streams – File Input Stream and File Output Stream – File Reader and File Writer. Object Serialization : Object Input Stream and Object Output Stream | | **CO4** |
| **Unit- V** | **GUI and JDBC** | **Periods:09** |
| **AWT**: Components – Controls – Event Handling<br>**SWING**: Swing Components – Layout Management.<br>**JDBC:** JDBC Architecture – JDBC Driver Types – Implementation of JDBC. | | **CO5** |

| **LecturePeriods:45** | **Tutorial Periods:** | **Practical Periods:** | **TotalPeriods:45** |
|---|---|---|---|

**Text Books**

1. Allen B. Downey and Chris Mayeld, “Think Java - How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2020
2. Herbert Schildt, “Java: The Complete Reference”, TMH Publishing Company Ltd, 11th Edition, 2018.
3. H.M. Dietel and P.J. Dietel, “Java How to Program”, 11th Edition, Pearson Education/PHI, 2017
4. Cay S. Horstmann, Gary Cornell, “Core Java Volume - I Fundamentals”, 9th Edition, Prentice Hall, 2013.



**Reference Books**

1. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018.
2. PoaulDeitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
3. P.J. Dietel and H.M Dietel, "Java for Programmers", Pearson Education, 9th Edition, 2011.
4. Steven Holzner, "Java 2 Black book", Dreamtech Press, 2011.

**Web References**

1. https://www.javatpoint.com/java-tutorial
2. https://docs.oracle.com/en/java/
3. https://www.studytonight.com/java/
4. https://onlinecourses.nptel.ac.in/

## COs/POs/PSOs Mapping

| | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 1 | - | 1 | - | - | - | - | - | - | 2 | 3 | 2 | 1 |
| 2 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | 2 | 3 | 2 | 1 |
| 3 | 3 | 3 | 3 | 1 | 3 | - | - | - | - | - | - | 2 | 3 | 2 | 1 |
| 4 | 3 | 3 | 3 | 1 | 3 | - | - | - | - | - | - | 2 | 3 | 2 | 1 |
| 5 | 3 | 3 | 3 | 1 | 3 | - | - | - | - | - | - | 2 | 3 | 2 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

## Evaluation Method

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 10 | | 5 | 5 | 5 | 75 | 100 |

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT505** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Industrial Instrumentation** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

ICE

| Prerequisite | Transducer engineering, Electrical and Electronic Measurements | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Familiarize with different temperature scales and their applications | **K2** |
| | **CO2** Utilize Various Pressure Measurement Devices | **K2** |
| | **CO3** Comprehend different methods of level measurement | **K2** |
| | **CO4** Understand Electrical and Modern Flow Meters | **K2** |
| | **CO5** Utilize various sensors and instruments for accurate and reliable measurements | **K2** |

| **UNIT –I** | **Temperature Measurement** | **Periods:9** | |
|---|---|---|---|
| Introduction to the industrial instrumentation- Need for industrial instrumentation-Industrial process variables- Temperature scales, Bimetallic thermometer, filled- in Thermometers, Vapour pressure thermometers, Resistance DC thermometers, Thermistors, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers. | | | **CO1** |
| **UNIT –II** | **Pressure Measurement** | **Periods:9** | |
| Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, lionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester | | | **CO2** |
| **UNIT –III** | **Level Measurement** | **Periods:9** | |
| Level measurement: Float gauges - Displacer type – D/P methods -Bubbler System-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement: – Differential pressure method and Hydrastep method - Solid level measurement. | | | **CO3** |
| **UNIT –IV** | **Flow Measurement** | **Periods:9** | |
| Variable Head Type Flow meter: Orifice plate: different types of orifice plates – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube- Positive displacement flow meters:Nutating disc, Reciprocating piston and oval gear flow meters – Inferential meter – Turbine flow meter- Mass flow meter, Coriolis type mass flow meters – Calibration of flow meters: – Dynamic weighing method. Electrical type flow meter: Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer | | | **CO4** |
| **UNIT –V** | **Smart Transmitters & Miscellaneous Measurements** | **Periods:9** | |
| Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Radar level transmitter-Installation and Calibration of smart and conventional transmitters.<br>Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope.<br>Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers<br>Humidity: Dry and wet bulb psychrometers – Dew cell<br>Moisture: Different methods of moisture measurements –Thermal, Microwave, IR and NMR sensors. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Doebelin, “Measurement Systems – Application and Design”, Tata McGraw Hill publishing company, 2012.
2. R.K. Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi, 2019.
3. D. Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill Publishing Company Ltd, 2013.

**Reference Books**

1. A.K. Sawhney and P. Sawhney, “A Course on Mechanical Measurements, Instrumentation and Control”, Dhanpath Rai and Co, 2013.
2. S.K. Singh, “Industrial Instrumentation and Control”, Tata McGraw Hill, 2014.
3. D.P. Eckman, “Industrial Instrumentation”, Wiley Eastern Ltd., 2012.
4. P.Holman, “Experimental Methods for Engineers”, International Student Edition, McGraw Hill Book Company, 2013.

5. Andrew W.G, “Applied Instrumentation in Process Industries – A survey”, Vol. 1 & Vol.2, Gulf Publishing Company, Houston, 2012.

**Web References**

1. https://lecturenotes.in/subject/42/industrial-instrumentation-ii
2. https://www.scribd.com/i/260674587/Industrial-Instrumentation-Notes.
3. https://nptel.ac.in/courses/108/105/108105064/.
4. https://www.youtube.com/playlist?list=PLUtfVcb-iqn_Dq6RnkCaOaLjPDu3cmxpo.
5. https://nptel.ac.in/courses/108/106/108106074/

*TE – Theory Exam, LE –Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 3 | 3 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 5 | 3 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |

Correlation Level: 1 - Low, 2 – Medium, 3 - High

**Evaluation Methods**

| Assessment | Continuous Assessment Marks(CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT1 | CAT2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **V** | Course Category Code: **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT506** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Embedded System Design** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| | ICE | | | | | | | |
| Prerequisite | Microprocessor and Microcontroller | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping(Highest Level) |
|---|---|---|
| **CO1** | Understand the fundamentals of embedded system, its features and applications. | **K2** |
| **CO2** | Explain the ARM cortex-M series architecture. | **K2** |
| **CO3** | Configure, program and debug the STM32F4XX series microcontroller | **K3** |
| **CO4** | Understand and implement the principles of embedded networking protocols | **K2** |
| **CO5** | Describe the concepts of real-time operating systems | **K3** |

| | | | |
|---|---|---|---|
| **UNIT –I** | **Embedded System Fundamentals** | **Periods:09** | |
| Introduction to embedded systems, Embedded systems vs general computing system, classification of embedded system, Challenges and design considerations of embedded systems, - selection of microcontrollers- Major application areas of embedded system – IDE, Embedded Firmware development tools -Compiler/Assembler, linker/locator, Simulator/Emulator. | | | **CO1** |
| **UNIT –II** | **ARM-Cortex M Series Architecture** | **Periods:09** | |
| ARM 32-bit microcontroller architecture—technology overview, Architectural Features of ARM Cortex M series (STM32F4XX series): Block Diagram, CPU modes, register organization, ROM, RAM, data and address bus, Memory mapped I/O and I/O mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, pipelining, exceptions, and its handling. | | | **CO2** |
| **UNIT –III** | **ARM-Cortex development tools** | **Periods:09** | |
| STM32F4XX series -Nucleo or discovery development board, -CubMX I/O programming-LED interfacing, switch interfacing, sensor Interfacing, Timers- PWM and Interrupt programming. ADC , DAC | | | **CO3** |
| **UNIT –IV** | **Embedded Networking** | **Periods:09** | |
| Buses & Protocols – Serial and Parallel communication protocols - RS 232, RS-485, I2C, SPI, UART, USB, CAN, AMBA. Ethernet, WLAN, Bluetooth, Zigbee. | | | **CO4** |
| **UNIT –V** | **Real-Time Operating system** | **Periods:09** | |
| OS Concepts and types, tasks & task states, process, threads, multiprocessing and multitasking, scheduling, task communication, task synchronization, RTOS Selection, Case studies- Air bag deployment system, Home automation. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Alexander G. Dean, Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach, ARM Education media, 2021.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, “COMPUTER ORGANIZATION AND EMBEDDED SYSTEMS, Sixth Edition, McGraw Hill, 2012.
3. Johnathon M Valvano, Embedded Systems: Introduction to ARM Cortex M Microcontrollers, 5th Edition, 2017.

**Reference Books**

1. Haung, H.W., “The HCS12 / 9S12: An Introduction to Software and Hardware Interfacing, Delmar Learning”, 2010.
2. Steve Furber, “ARM System-on-Chip Architecture, Second Edition, PEARSON, 2013.
3. Andrew N. Sloss, Dominic Symes, Chris Wright “ARM System Developers Guide, Designing and Optimizing System Software”, Elsevier Publication, 2004.
4. Milan Sanka, Vaclav Halavac, Roger Boyle “Image Processing, analysis and machine vision”, Springer Publisher, 2013.
5. Ray, A.K., “Advance Microprocessors and Peripherals – Architecture”, Programming and Interfacing, Tata McGraw-Hill, 2009.

**Web References**

1. https://www.geeksforgeeks.org/real-time-operating-system-rtos/
2. https://developer.arm.com/Processors/Cortex-M4
3. https://developer.arm.com/documentation/100166/0001/Programmers-Model
4. https://embedthreads.com/wp-content/uploads/2023/09/Muhammad-Ali-Mazidi.pdf

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | - | 3 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | 3 | 2 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 5 | 3 | 2 | 2 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |

Correlation Level: 1 - Low, 2 – Medium, 3 - High

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Information Technology** | | | Programme: **B.Tech** | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | | | Course Category Code: **ES** | | *End Semester Exam Type: **LE** | | |
| Course Code | **U23ITPC02** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Programming in Java Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| (Common to All Branches) | | | | | | | | |
| Prerequisite | Basic concepts of Object-Oriented Programming Principles | | | | | | | |

| Course Outcome | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Apply and practice logical formulations to solve simple problems leading to specific applications. | **K3** |
| | **CO2** Demonstrate the use of inheritance, interface and package in relevant applications | **K3** |
| | **CO3** Implement robust application programs in Java using exception handling and multithreading | **K3** |
| | **CO4** Build java distributed applications using Collections and IO streams. | **K3** |
| | **CO5** Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java. | **K3** |

**List of Exercises**

1. Develop simple programs using java
2. Develop a java program that implements class and object.
3. Write a java program to find the frequency of a given character in a string
4. Write a java program to demonstrate inheritance and interfaces.
5. Develop a java program that implements the Packages.
6. Create java applications using Exception Handling for error handling.
7. Develop a simple real life application program to illustrate the use of Multi-Threads.
8. Implement simple applications using Collections.
9. Develop application using the concept of I/O Streams
10. Write a Java Program to demonstrate AWT and Swing Components
11. Develop a simple application and use JDBC to connect to a back-end database.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods:30** | **Total Periods:30** |
|---|---|---|---|

**Reference Books**

1. Allen B. Downey and Chris Mayeld, “Think Java - How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2020
2. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018
3. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education, 7th Edition, 2010

**Web References**

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM’s tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog.
5. https://www.geeksforgeeks.org.

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **2** | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **3** | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **4** | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| **5** | 3 | 2 | 1 | 1 | 3 | - | - | - | - | - | - | - | 3 | 2 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

Academic Curriculum 2023-2024

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme:**B.Tech** | | | | | | |
| Semester | **V** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP506** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Embedded System Design Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| | | ICE | | | | | | |
| Prerequisite | **Microprocessor and Microcontroller** | | | | | | | |

| | | | |
|---|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Interface I/O device with STM32F4XX | **K2** |
| | **CO2** | Control DC and Stepper motor with STM32F4XX | **K3** |
| | **CO3** | Interface sensor and other peripherals using STM32F4XX | **K3** |
| | **CO4** | Comprehend communication features using STM32F4XX | **K3** |
| | **CO5** | Implement interrupt features using STM32F4XX | **K3** |

**List of Experiments**

1. Interface LED and keypad with STM32F4XX.
2. Interface LCD with STM32F4XX.
3. Control and interface DC motor using STM32F4XX.
4. Speed control of stepper motor using STM32F4XX.
5. Interface IR, LDR and temperature sensor with STM32F4XX.
6. Implementation of timer features with STM32F4XX.
7. PWM based LED brightness control using STM32F4XX.
8. Implementation of UART using STM32F4XX.
9. Implementation of I2C using STM32F4XX.
10. Implementation of ADC features with STM32F4XX.
11. Implementation of DAC features with STM32F4XX.
12. Implementation of interrupt features in STM32F4XX.

| | | | |
|---|---|---|---|
| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |

**Text Books**

1. Alexander G. Dean, Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach, ARM Education media, 2017.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, “Computer Organization and Embedded Systems, Sixth Edition, McGraw Hill, 2012.

**Reference Books**

1. Steve Furber, “ARM System-on-Chip Architecture, Second Edition, Pearson, 2013.
2. Andrew N. Sloss, Dominic Symes, Chris Wright “ARM System Developers Guide, Designing and Optimizing System Software”, Elsevier Publication.

**Web References**

1. https://developer.arm.com/Processors/Cortex-M4
2. file://datacenter/COMMON%20SHARING%203/ice/odd%2024/8%20BOS/esd/Scheme%202022.pdf
3. https://developer.arm.com/documentation/100166/0001/Programmers-Model

## COs/POs/PSOs Mapping

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 |
| 2 | 3 | 2 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | 2 |
| 3 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 4 | 2 | 2 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | 3 | 3 |
| 5 | 3 | 2 | 3 | - | 2 | - | - | - | - | - | - | - | 2 | 3 | 3 |

**Correlation Level: 1 - Low, 2 – Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP507** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Industrial Instrumentation Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |
| | | ICE | | | | | | |
| Prerequisite | **Transducer Engineering** | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Determine the viscosity and pressure in the industrial process. | **K2** |
| | **CO2** Comprehend the flow of the industrial process. | **K2** |
| | **CO3** Measure the level parameter of the industrial process. | **K2** |
| | **CO4** Measure the temperature of industrial process. | **K2** |
| | **CO5** Measure and analyze pH and conductivity value of different solutions**.** | **K2** |

**List of Experiments**

1. Measurement of Viscosity using saybolt viscometer.
2. Calibration of pressure gauge using dead weight tester.
3. Measurement of level using d/p transmitter.
4. Measurement of flow using Discharge coefficient of orifice plate
5. Calibration of manometer.
6. Calibration of I to P and P to I converters.
7. Calibration of RTD and Thermocouple.
8. Standardization and measurement of pH values of different solutions
9. Standardization and measurement of conductivity of different solutions
10. Calibration of Torque meter.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Text Books**

1. O. Doebelin, “Measurement Systems – Application and Design”, Tata McGraw Hill publishing company, 2012.
2. R.K. Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi, 2019. 3. D. Patranabis, “Principles of Industrial
3. Instrumentation”, Tata McGraw Hill Publishing Company Ltd, 2013.

**Reference Books**

1. A.K. Sawhney and P. Sawhney, “A Course on Mechanical Measurements, Instrumentation and Control”, Dhanpath Rai and Co, 2013.
2. S.K. Singh, “Industrial Instrumentation and Control”, Tata McGraw Hill, 2014.
3. D.P. Eckman, “Industrial Instrumentation”, Wiley Eastern Ltd., 2012.

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| **COs** | **Program Outcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **1** | 3 | 2 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | 3 | 2 |
| **2** | 3 | 3 | 2 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | 2 |
| **3** | 3 | 2 | 2 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| **4** | 2 | 3 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | 3 | 3 |
| **5** | 3 | 3 | 2 | - | 2 | - | - | - | - | - | - | - | 2 | 3 | 3 |

**Correlation Level: 1 - Low, 2 – Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |



| Department | **Instrumentation and Control Engineering** | | | Programme: **B. Tech.** | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | | | Course Category Code: **PA** | | | *End Semester Exam Type: **-** | |
| Course Code | **U23ICW501** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Micro Project** | **0** | **0** | **2** | **1** | **100** | **-** | **100** |
| ICE | | | | | | | | |
| Prerequisite | Electron Devices and Circuits, Transducer Engineering | | | | | | | |

| Course Outcomes | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Identify the problem statement for the micro project work through the literature survey | **K2** |
| | **CO2** Choose the proper components as per the requirements of the design/ system. | **K2** |
| | **CO3** Apply the acquainted skills to develop final model/system | **K3** |

There shall be a Micro Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the micro project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Micro-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Micro Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Micro Project work with weightage as indicated evaluation Methods.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**COs/POs/PSOs Mapping**

| **COs** | **Program Outcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **1** | 3 | 2 | 2 | 2 | - | - | - | - | 3 | 3 | - | 1 | 1 | 1 | 1 |
| **2** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 2 | 2 |
| **3** | 3 | 2 | 2 | 1 | - | 2 | - | - | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

**Correlation Level: 1 – Low, 2 – Medium, 3 -High**

**Evaluation Method**

| Assessment | Review 1 | | | Review 2 | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | Novelty | Presentation | Viva | Presentation | Demonstration | Viva | Report | |
| Marks | 10 | 20 | 10 | 20 | 20 | 10 | 10 | 100 |



| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category: **AEC** | | | End Semester Exam Type: **-** | | | |
| Course Code | **U23ICC5XX** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Certification Course - V** | **0** | **0** | **4** | **-** | **100** | **-** | **100** |
| ICE | | | | | | | | |
| Prerequisite | **-** | | | | | | | |

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

## Evaluation Methods

| **Assessment** | **Continuous Assessment Marks (CAM)** | | **Total Marks** |
|---|---|---|---|
| | **Attendance** | **MCQ Test** | |
| **Marks** | **10** | **90** | **100** |

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **MC** | | | *End Semester Exam Type: **-** | | | |
| Course Code | **U23ICM505** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Essence of Indian Traditional Knowledge** | **2** | **0** | **0** | **-** | **100** | **-** | **100** |

Common to ALL Branches

Prerequisite: **-**

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Familiarize with the philosophy of Indian culture | **K2** |
| | **CO2** Distinguish the Indian languages and literature | **K2** |
| | **CO3** Describe the philosophy of ancient, medieval and modern India | **K2** |
| | **CO4** Illustrate the information about the fine arts in India | **K2** |
| | **CO5** Describe the contribution of scientists of different eras | **K2** |

| **UNIT- I** | **Introduction To Culture** | **Periods:06** | |
|---|---|---|---|
| Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India | | | **CO1** |
| **UNIT- II** | **Indian Languages, Culture and Literature** | **Periods:06** | |
| Indian Languages and Literature - I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature | | | **CO2** |
| **UNIT- III** | **Religion and Philosophy** | **Periods:06** | |
| Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only) | | | **CO3** |
| **UNIT- IV** | **Fine Arts in India (Art, Technology and Engineering)** | **Periods:06** | |
| Indian Painting, Indian handicrafts, Music, divisions of Indian classical music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India | | | **CO4** |
| **UNIT-V** | **Education System in India** | **Periods:06** | |
| Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India | | | **CO5** |

| **Lecture Periods:30** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods:30** |
|---|---|---|---|

**Reference Books**

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”, ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. S. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978 - 8120810990, 2014

**Web References**

1. https://nptel.ac.in/courses/109/104/109104102/
2. https://nptel.ac.in/courses/101/104/101104065/
3. https://nptel.ac.in/courses/109/108/109108158/
4. https://nptel.ac.in/courses/109/106/109106059/
5. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ae01/

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 2 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 3 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 4 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 5 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | Total Marks |
|---|---|---|---|---|
| | Attendance | MCQ Test | Presentation / Activity / Assignment | |
| Marks | 10 | 30 | 60 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VI** | Course Category Code: **PC** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT607** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Analytical Instrumentation** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| | | ICE | | | | | | |
| Prerequisite | Physics | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Understand the fundamental principle and application of spectrophotometry. | **K3** |
| **CO2** | Gain knowledge on the chromatographic behaviour of solutes in gas and liquid state. | **K3** |
| **CO3** | Critically evaluate the strengths and limitations of the various pollution monitoring instrumental methods. | **K3** |
| **CO4** | Acquaint on PH meters and dissolved component analyzers. | **K3** |
| **CO5** | Understand the working principle, types and applications of NMR and Mass spectroscopy. | **K3** |

| | | | |
|---|---|---|---|
| **UNIT –I** | **Spectrophotometry** | **Periods:09** | |
| Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – Single beam and double beam Instruments- IR Spectrophotometer - FTIR spectrophotometer – Atomic absorption spectrophotometer - Flame emission and atomic emission photometry – Construction, working principle, sources, detectors and applications. | | | **CO1** |
| **UNIT –II** | **Chromatography** | **Periods:09** | |
| General principles – classification – chromatographic behaviour of solutes – quantitative determination – Gas chromatography – Liquid chromatography –High Pressure liquid Chromatography (HPLC), application. | | | **CO2** |
| **UNIT –III** | **Industrial Gas Analyzers and Pollution Monitoring instruments** | **Periods:09** | |
| Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, Thermal Analyzer, analysis based on ionization of gases. Air Pollution due to Carbon monoxide, Hydrocarbons, Nitrogen oxides, Sulphur dioxide estimation - Dust and smoke measurements. | | | **CO3** |
| **UNIT –IV** | **PH Meters and Dissolved Component Analyzers** | **Periods: 09** | |
| Selective ion electrodes - Principle of pH and conductivity measurements – dissolved oxygen analyzer- Sodium analyzer – Silicon analyzer – Water quality Analyzer- ORP analyzer. | | | **CO4** |
| **UNIT –V** | **Nuclear Magnetic Resonance and Mass Spectrometry** | **Periods: 09** | |
| NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry. | | | **CO5** |

| | | | |
|---|---|---|---|
| **LecturePeriods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **TotalPeriods:45** |

**Text Books**

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., “Instrumental methods of analysis”, CBS publishing & distribution, 7th Edition 2012.
2. Braun, R.D., “Introduction to Instrumental Analysis”, Pharma Book Syndicate, Singapore, 2nd edition, 2012
3. Robert E. Sherman., “Analytical Instrumentation”, Instruments Society of America, 1996.

**Reference Books**

1. Khandpur, R.S., “Handbook of Analytical Instruments”, Tata McGraw-Hill publishing Co. Ltd., 2nd Edition 2007.
2. Ewing, G.W., “Instrumental Methods of Chemical Analysis”, McGraw-Hill, 5th Edition reprint 1985.
3. Liptak, B.G., “Process Measurement and Analysis”, CRC Press, 5th Edition, 2015.
4. Dr.J.R. Mudakavi, “Modern Instrumental methods of Analysis”, NPTEL lecture notes, IISC, Bangalore, 2019.

**Web References**

1. https://www.slideshare.net/ErFarukBinPoyen/analytical-instrumentation-introduction.
2. https://www.youtube.com/watch?v=AkXRYGwlbL4
3. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/IC0309%20Analytical%20Instumentation.pdf

*TE – Theory Exam, LE –Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 2 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 3 | 2 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 4 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 5 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks(CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VI** | Course Category Code: **PC** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT608** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Power Plant Instrumentation** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| Prerequisite | Industrial Instrumentation | | | | | | | |

| **Course Outcomes** | **On completion of the course the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Understand and analyze about the various Power Generation Methods. | **K2** |
| **CO2** | Comprehend basic measurement in power plants. | **K2** |
| **CO3** | Recognize various analyzers for monitoring feed water impurity, flue gas etc. | **K2** |
| **CO4** | Acquaint knowledge on various Instruments used in nuclear power plants. | **K2** |
| **CO5** | Gain knowledge to control and monitor the turbines. | **K2** |

| | | | |
|---|---|---|---|
| **UNIT –I** | **OVERVIEW OF POWERGENERATION** | **Periods:9** | |
| Brief Survey methods of power generation:– hydro, thermal, nuclear, solar and wind power– Importance of instrumentation in power generation – Thermal power plant – Building blocks - Combined Cycle System – Combined Heat and Power System – sub critical and supercritical boilers. | | | **CO1** |
| **UNIT –II** | **MEASUREMENTS IN POWER PLANTS** | **Periods:9** | |
| Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement – Steam pressure and temperature measurement – radiation detector – smoke density measurement– Flue gas analyzer – Fuel composition analyzer. | | | **CO2** |
| **UNIT –III** | **BOILER CONTROL** | **Periods:9** | |
| Combustion of fuel and excess air – Firing rate demand – Steam temperature control – Steam & Water Analysis system -Control of deaerator – Drum level control – Single, two and three element control – Furnace draft control –implosion - flue gas dew point control – Trimming of combustion air – Soot blowing. | | | **CO3** |
| **UNIT –IV** | **NUCLEAR POWER PLANT INSTRUMENTATION** | **Periods:9** | |
| Piping and instrumentation diagram of different types of nuclear power plants-radiation detection instruments-process sensors for nuclear power plants-spectrum analyzers-nuclear reactor control systems and allied instrumentation. | | | **CO4** |
| **UNIT –V** | **TURBINE MONITORING AND CONTROL** | **Periods:9** | |
| Speed, vibration, shell temperature monitoring and control – Steam pressure control – Lubricant oil temperature control – Cooling system. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **TotalPeriods:45** |

**Text Books**

1. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2013.
2. P.K.Nag, Powerplant Engineering, Tata McGraw-Hill Education, 3rd edition,2011
3. David Lindsley, Power-plant Control and Instrumentation, The Control of Boilers and HRSG Systems, 2000.

**Reference Books**

1. Sam Dukelow, “Control of Boilers”, Instrument Society of America, 2012.
2. Jain R.K., “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi, 2012.
3. Singh, S. K., “Industrial Instrumentation and Control”, Tata- McGraw-Hill Publishing Company, ISBN-13: 978-0-07-026222-5, 2009.
4. K. Krishnaswamy, M. Ponnibala, “Power plant instrumentation”, 2013

**Web References**

1. www.ignou.ac.in/upload/Unit-2-58.pdf
2. http://www.powerplantinstrumentationcontrol.yolasite.com/
3. https://electrical-engineering-portal.com/download-center/books-and-guides/power-

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 2 | - | 1 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 2 | 3 | 2 | 3 | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 3 | 3 | 3 | 2 | - | 1 | - | - | - | - | - | - | - | 2 | 1 | 2 |
| 4 | 3 | 2 | 3 | - | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 5 | 3 | 1 | 2 | - | 1 | - | - | - | - | - | - | - | 2 | 1 | 2 |

Correlation Level: 1-Low, 2-Medium, 3- High

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VI** | Course Category Code: **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT609** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Process Control** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| ICE | | | | | | | | |
| Prerequisite | Industrial Instrumentation | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Acquaint the dynamics of various processes. | **K2** |
| | **CO2** Acquire knowledge on the characteristics, Selection and Sizing of final control elements. | **K2** |
| | **CO3** Describe the effect of various control actions. | **K2** |
| | **CO4** Interpret the evaluation criteria and tuning techniques of controllers. | **K2** |
| | **CO5** Comprehend the concept of multi loop control techniques. | **K2** |

| | | | |
|---|---|---|---|
| **UNIT –I** | **Process Modelling and Dynamics** | **Periods:9** | |
| Need for process control – Mathematical Modelling of Processes**:** Level, Flow, Pressure and Thermal processes – Interacting and non-interacting system - Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR. | | | **CO1** |
| **UNIT –II** | **Final Control Elements** | **Periods:9** | |
| Signal Conversions: I to P and P to I Converters - Actuators: Pneumatic and electric actuators –- Control Valves-Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner– Valve body:-Commercial valve bodies-Control Valve Sizing – Cavitation and flashing. | | | **CO2** |
| **UNIT –III** | **Control Actions** | **Periods:9** | |
| Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues**:** Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action | | | **CO3** |
| **UNIT –IV** | **PID Controller Tuning** | **Periods:9** | |
| PID Controller Design Specifications**:** Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning**:** Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning- Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio. | | | **CO4** |
| **UNIT –V** | **Control Techniques and Applications** | **Periods:9** | |
| Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range - Override Control and introduction to multivariable control–- IMC– Adaptive control – P&ID diagram. Case Studies: Control Schemes for Distillation Column-Three-element Boiler drum level control. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons,4th Edition, 2016.
2. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2nd Edition, 2023.
3. Stephanopoulos, G., “Chemical Process Control“, Prentice Hall of India, 2006.

**Reference Books**

1. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill International Education,3rd Edition,2013
2. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2013.
3. Considine, D.M., “Process Instruments and Controls Handbook”, Second Edition, McGraw, 5th Edition 2022.
4. Bela.G.Liptak., “Process Control and Optimization”, Instrument Engineers’ Handbook, Volume 2,CRC,2018.
5. D. P. Eckman, “Automatic Process control”, 7th Edition, John Wiley, New York, 1990.

**Web References**

1. http://www.pc-education.mcmaster.ca/
2. https://controlguru.com/
3. https://www.youtube.com/watch?v=eYrZcxOPVPE
4. http://www.instrumentationworld.com/instrumentation_tutorial.htm
5. http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm

*TE – Theory Exam, LE –Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes(POs) | | | | | | | | | | | | Program Specific Outcomes(PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 3 | - | 3 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| **2** | 3 | 2 | 2 | - | 2 | - | - | - | - | - | - | - | 3 | 1 | 2 |
| **3** | 3 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| **4** | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 1 | 3 |
| **5** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks(CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT1 | CAT2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VI** | Course Category Code: **PC** | | | | *End Semester Exam Type: **TE** | | |
| Course Code | **U23ICB603** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Internet of Things for Automation** | **2** | **0** | **2** | **3** | **50** | **50** | **100** |
| | | ICE | | | | | | |
| Prerequisite | Microcontroller | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Infer internet of Things and its components. | **K2** |
| | **CO2** Describe about Reference modules and Architecture. | **K2** |
| | **CO3** Explain the concepts of Hardware and Software Elements. | **K2** |
| | **CO4** Build and deploy various Functions with IoT elements. | **K2** |
| | **CO5** Develop real-time IoT based Applications. | **K2** |

| **UNIT –I** | **INTRODUCTION TO INTERNET OF THINGS** | **Periods:10** |
|---|---|---|
| The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT. | | **CO1** |
| **UNIT –II** | **ARCHITECTURE OF IoT** | **Periods:10** |
| State of the Art – Introduction, Architecture Reference Model- IoT reference Model, IoT Reference Architecture, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. | | **CO2** |
| **UNIT –III** | **ELEMENTS OF IoT** | **Periods:10** |
| Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.<br>Software Components- Programming APIs (using Python/Embedded C,C++) for Communication. | | **CO3** |
| **UNIT-IV** | | **Periods:15** |

**List of Experiments:**

1. Interfacing sensor with IoT device
2. Temperature and Humidity Logger using Thing Speak cloud
3. Smart Plant Monitoring System
4. DC motor monitoring and control using blynk app.
5. Home Automation using IoT cloud platform.
6. IoT Enabled parking management.

| **UNIT- V** | | **Periods:15** |
|---|---|---|

**List of Experiments:**

1. Smart Energy Meter System
2. Water Quality Monitoring System
3. Integrate SMTP Protocol in real time application.
4. Automatic Door Lock System
5. Smart waste bin monitoring with IoT
6. IoT based health monitoring system.

| **Lecture Periods: 30** | **Tutorial Periods:** | **Practical Periods: 30** | **Total Periods: 60** |
|---|---|---|---|

**Text Books**

1. Vijay Madisetti, ArshdeepBahga, “Internet of Things, A Hands-on Approach”, University Press,3rd edition, Aug 2018.
2. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill ISBN: 9789352605224, 9789352605224,2nd edition, May 2017.
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A Practical Approach”, ETI Labs 2014.

**Reference Books**

1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi, 2012.
2. Adrian McEwen, “Designing the Internet of Things”, Wiley, 2007

3. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill, 2002
4. CunoPfister, “Getting Started with the Internet of Things”, O Reilly Media, 2015
5. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press, 2017.

**Web References**

1. https://www.i-scoop.eu/internet-of-things-guide/
2. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
3. https://www.youtube.com/watch?v=eYrZcxOPVPE
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/preview

*TE – Theory Exam, LE –Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes(POs) | | | | | | | | | | | | Program Specific Outcomes(PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | - | - | 1 | 1 | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | 2 | 2 | - | - | 1 | 1 | - | - | - | - | - | 3 | 1 | 2 |
| 3 | 3 | 2 | 2 | - | - | 1 | 1 | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 3 | 3 | - | - | 1 | 1 | - | - | - | - | - | 3 | 1 | 3 |
| 5 | 3 | 2 | 1 | 1 | - | 1 | 1 | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

**Assessment method for theory cum practical course**

| Assessment | Continuous Assessment Marks(CAM)–Maximum 50 Marks | | | | | | | | | End Semester Examination (ESE) Marks (Theory) | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continuous Assessment (Theory) | | | | | Continuous Assessment(Practical) | | | | | |
| | CAT1 | CAT2 | Model | Attendance | Total | Conduction of Practical | Report | Viva | Total | #End Semester Examination (ESE) Marks (Practical – Internal Evaluation) | |
| Marks | 5 | 5 | 5 | 5 | 20* | 15 | 10 | 5 | 30* | | 75** | - |
| *Tobe weighted for 10 Marks | | | | | 10 | *Tobe weighted for 10 Marks | | | 10 | 30 | **To be weighted for 50 Marks | 100 |

# Final End Semester practical exam to be conducted with internal and external examiner by Head of the institution and HoD.

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VI** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP608** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Instrumentation System Design Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

| Prerequisite | | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Design, test and calibrate the industrial instruments. | **K1** |
| | **CO2** Understand design of signal conditioning circuits and instrumentation systems | **K2** |
| | **CO3** Calibrate different instruments used in industries. | **K3** |
| | **CO4** Design the multi-channel data acquisition system and transmitter | **K3** |
| | **CO5** Design the advanced measuring circuits. | **K2** |

**List of Experiments**

1. Design and Testing of Monolithic Function Generator using XR 2206
2. Design and Testing of Batch counter using TTL ICs.
3. Design and Testing of Regulated Power supplies.
4. Design and Testing of Electronic P, PI, PID & ON/OFF controllers.
5. Design and Testing of Programmable Timers.
6. Design and Testing of DAC and ADC
7. Design and Testing of Frequency to Voltage converters.
8. Design and Testing of Cold Junction compensation of a Thermocouple.
9. Design and Testing of Signal Conditioning Circuit of RTD.
10. Design and Testing of Voltage to Current converters.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Text Books**

1. Jacob Fraden, “Handbook of Modern Sensors Physics, design and Applications”, springer publication, 4th edition 2010.
2. GanjiVasu, “Design of Controller for Higher Order Discrete Systems”, LAP Lambert Academic Publishing, 26 November 2012.
3. D.Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.

**Reference Books**

1. A.K.Sawhney, “A course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai and Sons, New Delhi, 1999

**Web References**

1. https://dl.acm.org/doi/book/10.5555/269184.
2. https://nptel.ac.in/courses/108/105/108105064/
3. https://lecturenotes.in/subject/42/industrial-instrumentation-ii

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 3 | - | - | 2 | - | - | - | - | - | - | 3 | 2 | 3 |
| 2 | 2 | 1 | 3 | - | - | 1 | - | - | - | - | - | - | 3 | 2 | 3 |
| 3 | 2 | 1 | 3 | - | - | 2 | - | - | - | - | - | - | 3 | 3 | 3 |
| 4 | 3 | 1 | 3 | - | - | 2 | - | - | - | - | - | - | 3 | 3 | 3 |
| 5 | 3 | 1 | 3 | - | - | 2 | - | - | - | - | - | - | 3 | 3 | 3 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VI** | Course Category: **PC** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP609** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Process Control Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

| Prerequisite | | | |
|---|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Understand the practical issues of closed loop control of processes. | **K2** |
| | **CO2** | Comprehend process control system components to meet desired needs within realistic constraints. | **K2** |
| | **CO3** | Understand tuning of level, flow, temperature and pressure process. | **K2** |
| | **CO4** | Evaluate the dynamic behaviour of Interacting and Non-interacting System. | **K2** |
| | **CO5** | Acquire knowledge on PID enhancements. | **K2** |

**List of Experiments**

1. Study of Process Control Training System and Piping and Instrumentation diagram of a plant.
2. Study of Inherent and Installed Characteristics of Control Valves.
3. Tuning and closed loop control of soft process by Reaction Curve Method/Continuous Cycling Method.
4. Closed loop control of Level Process.
5. Closed loop control of Flow Process.
6. Closed loop control of Temperature Process.
7. Closed loop control of Pressure Process.
8. Determine the characteristics of ON/OFF Controller for the Temperature Process.
9. Obtain the characteristics of Interacting system.
10. Obtain the characteristics of Non-interacting system.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**Text Books**

1. N.A.Anderson, Instrumentation for Process Measurement and Control, Chilton Company, 2012.
2. D.M.Considine, Process Instruments and Controls Handbook, McGraw-Hill. 5th Edition 2022.
3. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill InternationalEducation3rdedition, 2013.

**Reference Books**

1. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2013.
2. D. P. Eckman, “Automatic Process control”, 7th Edition, John Wiley, New York, 1990.

**Web References**

1. https://nptel.ac.in/courses/103/103/103103037/
2. http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html
3. https://www.youtube.com/watch?v=J1-tzQtqifU

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 1 | 2 |
| 3 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 3 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | 1 | 3 |
| 5 | 3 | 2 | 1 | - | 1 | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VI** | Course Category:**PC** | | | *End Semester Exam Type:**LE** | | | |
| Course Code | **U23ICP610** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Virtual Instrumentation Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

| Prerequisite | Basic Electronics Laboratory | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Get adequate knowledge on VI tool sets | **K2** |
| | **CO2** Describe the data acquisition. | **K2** |
| | **CO3** Attain knowledge on VI programming techniques. | **K3** |
| | **CO4** Understand VI programming techniques. | **K3** |
| | **CO5** Get an adequate knowledge on application of virtual instrumentation | **K2** |

1. Creating Virtual Instrumentation for simple applications.
2. Programming exercises for loops and charts
3. Programming exercises for clusters and graphs.
4. Programming exercises on case and sequence structures, file Input / Output.
5. Data acquisition through Virtual Instrumentation.
6. Developing voltmeter using DAQ cards.
7. Developing signal generator using DAQ cards.
8. Simulating reactor control using Virtual Instrumentation.
9. Real time temperature control using Virtual Instrumentation.
10. Real time sequential control of any batch process.

| **Lecture Periods:** | **Tutorial Periods:-** | **Practical Periods:30** | **Total Periods:30** |
|---|---|---|---|

**Reference Books**

1. Sanjay Gupta, “Virtual Instrumentation using LABVIEW” Prentice Hall India Learning Private Limited 2010
2. Jeffrey Y Beyon,”Hands-On Exercise Manual for LabVIEW Programming, Data Acquisition and Analysis”, Prentice Hall 2000.
3. Saanjay Gupta and Joseph John, “Virtual Instrumentation using LAbVIEW”,Tata Mc Graw Hill 2006.
4. S.Sumathi,P.Surekha,“LabVIEW Based Advanced Instrumentation Systems”,Springer,2007.
5. Jovitha Jerome,”Virtual Instrumentation using LAbVIEW”,Prentice Hall India Learning Private Limited 2010

**Web References**

1. https://www.ni.com
2. https://www.sciencedirect.com/topics/engineering/virtual-instrument
3. http://jjackson.eng.ua.edu/courses/ece380/assignments/373363c.pdf

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |
| **2** | 3 | 1 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| **3** | 3 | 1 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | 3 | 2 |
| **4** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 2 |
| **5** | 3 | 2 | 1 | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks(CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
| Semester | **VI** | Course Category Code: **PA** | | | *End Semester Exam Type: **-** | | | |
| Course Code | **U23ICW602** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Mini Project** | **0** | **0** | **2** | **1** | **100** | **-** | **100** |
| **ICE** | | | | | | | | |
| Prerequisite | Electron Devices and Circuits, Transducer Engineering, C Programming | | | | | | | |

| Course Outcomes | | On completion of the course, the students will be able to | BT Mapping (Highest Level) |
|---|---|---|---|
| | **CO1** | Identify the problem statement for the mini project work through the literature survey | **K2** |
| | **CO2** | Choose the proper components as per the requirements of the design/ system. | **K2** |
| | **CO3** | Apply the acquainted skills to develop final model/system | **K3** |

There shall be a Mini Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the mini project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Mini-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Mini Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Mini Project work with weightage as indicated evaluation Methods.

| **Lecture Periods: -** | **Tutorial Periods: -** | **Practical Periods: 30** | **Total Periods: 30** |
|---|---|---|---|

**COs/POs/PSOs Mapping**

| **COs** | **Program Outcomes (POs)** | | | | | | | | | | | | **Program Specific Outcomes (PSOs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **1** | 3 | 2 | 2 | 2 | - | - | - | - | 3 | 3 | - | 1 | 1 | 1 | 1 |
| **2** | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 2 | 2 | 2 |
| **3** | 3 | 2 | 2 | 1 | - | 2 | - | - | 3 | 3 | 3 | 1 | 2 | 2 | 2 |

**Correlation Level: 1 – Low, 2 – Medium, 3 – High**

**Evaluation Method**

| Assessment | Review 1 | | | Review 2 | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | Novelty | Presentation | Viva | Presentation | Demonstration | Viva | Report | |
| Marks | 10 | 20 | 10 | 20 | 20 | 10 | 10 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
| Semester | **VI** | Course Category: **AEC** | | | End Semester Exam Type: **-** | | | |
| Course Code | **U23ICC6XX** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Certification Course - VI** | **0** | **0** | **4** | **-** | **100** | **-** | **100** |
| **ICE** | | | | | | | | |
| Prerequisite | **-** | | | | | | | |

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as “pass” on satisfactory completion. A letter grade “P” is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

**Evaluation Method**

| **Assessment** | **Continuous Assessment Marks (CAM)** | | **Total Marks** |
|---|---|---|---|
| | **Attendance** | **MCQ Test** | |
| **Marks** | **10** | **90** | **100** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B. Tech.** | | | | | | |
| Semester | **VI** | Course Category: **MC** | | | End Semester Exam Type : | | | |
| Course Code | **U23ICM606** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Gender Equality** | **2** | **0** | **0** | **-** | **100** | **-** | **100** |

| | | | |
|---|---|---|---|
| Prerequisite | **-** | | |
| Course Outcomes | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Describe the general identity, social construction of gender roles. | **K2** |
| | **CO2** | Illustrate the causes and issues of gender discrimination in Indian society. | **K2** |
| | **CO3** | Describe the workplace discrimination, media influences on gender and culture. | **K2** |
| | **CO4** | Familiarize with international and Indian frameworks on gender equality. | **K2** |
| | **CO5** | Illustrate the current challenges in gender equality, including the glass ceiling and the role of technology. | **K2** |

| | | | |
|---|---|---|---|
| **UNIT -I** | **Introduction to Gender Equality** | **Periods:06** | |
| Gender equality - exploring gender identity and expression, Understanding the social construction of general roles and norms, historical perspectives on gender roles, Analyzing key milestones in the fight for gender equality. | | | **CO1** |
| **UNIT - II** | **Gender Inequality and Its Manifestations** | **Periods:06** | |
| Gender discrimination in Indian society - causes of gender inequality - Illiteracy, patriarchal set up, lack of awareness, social beliefs, practice and custom - Issues of gender discrimination - Child marriage, child domestic work, poor education and health, violence and exploitation in workplace. | | | **CO2** |
| **UNIT - III** | **Gender and Culture** | **Periods:06** | |
| Workplace discrimination, Media influences on gender and culture, Gender and power dynamics in society. Strategies for promoting gender equality and cultural understanding. | | | **CO3** |
| **UNIT - IV** | **Promoting Gender Equality** | **Periods:06** | |
| Gender Equality and Human Rights - International frameworks and Conventions on Gender Equality - Equality under the Indian Constitution - Policies and initiatives for gender mainstreaming - Strategies for promoting Gender Equality in various contexts. | | | **CO4** |
| **UNIT - V** | **Contemporary Challenges and Future Directions** | **Periods:06** | |
| Current challenges and emerging issues in gender equality- Glass ceiling - role of technology in continuing or challenging gender inequality - Exploring possibilities for transformative change and envisioning a gender-equal future. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods: 30** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 30** |

**Text Books**

1. "Gender and Society" by Raewyn Connell - This book provides a comprehensive overview of gender roles, power dynamics, and the social construction of gender.
2. "The Second Sex" by Simone de Beauvoir - A historical and philosophical examination of women's oppression and gender inequality.
3. "Women and Gender in the Indian Society" by Neera Desai and Usha Thakkar – Focuses on the context of gender roles, inequality, and feminist movements in India.

**Reference Books**

1. Woman in early Indian societies, New Delhi: Manohar Publications. Sita A. Raman (2009).
2. A social and Cultural history, Volume1. Connecticut: Oxford: Praeger. Sita Raman (2009).
3. A social and Cultural history, Volume2. Connecticut: Oxford: Praeger.
4. Iftikhar R. (2016). Indian Feminism: Class, Gender and Identity in Medieval Ages. Chennai: Notion Press. Iftikhar, R. (2012).

**Web References**

1. https://www.unwomen.org
2. https://ncw.nic.in
3. https://en.unesco.org/themes/gender-equality
4. https://www.weforum.org/reports
5. https://wcd.nic.in

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 2 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 3 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 4 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |
| 5 | 1 | - | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | Total Marks |
|---|---|---|---|---|
| | Attendance | MCQ Test | Presentation / Activity / Assignment | |
| Marks | 10 | 30 | 60 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VII** | Course Category Code: **PC** | | | *End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICT710** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Industrial Safety** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| | | | |
|---|---|---|---|
| Prerequisite | Transducer and Measurement | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Understand the basic concept of safety | **K2** |
| | **CO2** | Obtain knowledge of Statutory Regulations and standards. | **K2** |
| | **CO3** | Develop safety programs to prevent or mitigate damage or losses. | **K2** |
| | **CO4** | Understand the fault tracing in machineries. | **K2** |
| | **CO5** | Elucidate safety instrumentation followed in process industries | **K2** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Safety and Standards** | **Periods:09** | |
| Concepts - Evolution, factories act 1948 for health and safety, Concept of an accident, Accident causation models, cost of accident, investigation, Accident Reporting and Investigation, Safety Performance Monitoring - Safety indices. | | | **CO1** |
| **UNIT – II** | **Safety Activities** | **Periods:09** | |
| Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment. | | | **CO2** |
| **UNIT – III** | **Introduction To Maintenance Engineering** | **Periods:09** | |
| Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost and its relation with replacement economy, Service life of equipment. | | | **CO3** |
| **UNIT – IV** | **Fault Tracing** | **Periods:09** | |
| Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, and electrical equipment like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. | | | **CO4** |
| **UNIT – V** | **Safety In Instrumentation Systems** | **Periods:09** | |
| Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards –Hazard and Risk Assessment – Failure modes – Operation and Maintenance. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**


1. P. Gopalakrishnan, “Maintenance and Spare Parts Management”, 2nd edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
2. Keith Mobley, “Maintenance Engineering Handbook”, McGraw-hill education, 8th edition, 2014.
3. Frank R. Spellman, “Occupational Safety and Health Simplified for the Industrial Workplace”, CRC Press, 2nd edition, 2015.


**Reference Books**


1. M.P.Poonia, S.C.Sharma, “Industrial Safety Maintenance Management”, Khanna Publication, 2018.
2. Sushil Kumar Srivastava, Maintenance Engineering and Management, S. Chand and Company Ltd, 2006.
3. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey, 1973.
4. Roger L Brauer, “Safety and Health for Engineers”, Wiley, 3rd Edition, 2016.
5. Austin, G.T. and Shreeves, A.G.T., “Chemical Process industries”, McGraw-Hill, 2012.


**Web References**

1. https://www.safeopedia.com/definition/1052/industrial-safety
2. https://www.nistinstitute.com/blog/industrial-safety-scope-significance/
3. https://labour.gov.in/industrial-safety-health
4. https://libguides.ilo.org/occupational-safety-and-health-en/links?utm_source=chatgpt.com
5. https://www.ishn.com/?utm_source=chatgpt.com

* TE – Theory Exam, LE – Lab Exam





Dr. L. M. Varalakshmi

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | - | - | 1 | - | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | - | - | - | - | 1 | - | - | - | - | - | - | 3 | 1 | 2 |
| 3 | 3 | - | - | - | - | 1 | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 3 | 3 | - | - | 1 | - | - | - | - | - | - | 3 | 1 | 3 |
| 5 | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. L. M. Varalakshmi

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category : **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT711** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Instrumentation in Biomedical Applications** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | **Sensors and Measurement Techniques** | | |
|---|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Explain the structure of cell, physiology of different biological systems and their functions. | **K2** |
| | **CO2** | Illustrate the types of electrodes and measurements of biological parameters. | **K2** |
| | **CO3** | Explain the working of non-electrical parameter measurement. | **K2** |
| | **CO4** | Analyze the measurements of therapeutic instruments. | **K3** |
| | **CO5** | Elucidate the working of medical imaging techniques. | **K2** |

| **UNIT- I** | **Electrophysiology** | **Periods:09** |
|---|---|---|
| Cell and Its Structure, Action and Resting Potential, Nernst Equation, Sources of Biomedical Signals-Physiology of Heart, Lung, Kidney. Organization of Nervous System, CNS, PNS, Neurons, Axons, Synapse, Propagation of Electrical Impulses along the Nerve-Sodium Pump- Role of Engineers in Healthcare Facilities. | | **CO1** |
| **UNIT- II** | **Electro Physiological Measurements** | **Periods:09** |
| **Design of Medical Instruments** - Biomedical Instrument System, Electrodes: Micro Electrodes, Needle Electrodes, Surface Electrodes. **Bio amplifier:** Instrumentation amplifier, Isolation Amplifier, Preamplifier, Current Amplifier, Chopper Amplifier- ECG Lead Configuration, Vector cardiograph, Phono-cardiograph, EEG and EMG -Measurement- Electric shock hazards and leakage currents. | | **CO2** |
| **UNIT- III** | **Non-Electrical Parameter Measurement** | **Periods:09** |
| **Blood Pressure Measurement:** Indirect methods of blood pressure measurement, Direct measurement techniques, automated indirect measurement, Korotkoff's method.<br>**Blood flow measurement:** pH measurement, blood pCO2, blood pO2, Blood gas analyzer.<br>**Cardiac output measurement:** Indicator dilution, thermal dilution and dye dilution method.<br>**Respiratory rate measurement**- artificial respirator- oximeter,<br>**Pulmonary function measurements:** spirometer– plethysmography. Patient Monitoring System, ICCU, Bone Density Measurement | | **CO3** |
| **UNIT- IV** | **Assisting and Therapeutic Equipment** | **Periods:09** |
| Biomedical Telemetry: Single Channel Telemetry, Multi-channel Telemetry, Implantable Telemetry, Wireless Telemetry, Telemedicine, Telemedicine Applications, Dialysers, Haemodialysis Machine, Ventilators, Surgical Diathermy, Pace Makers, Defibrillators, Electro Anaesthetic. Stem Cell Therapy.<br>**Case study: Telemedicine based health care monitoring system.** | | **CO4** |
| **UNIT-V** | **Medical Imaging Techniques** | **Periods:09** |
| Ultrasonic Diagnosis, Ultrasonic Scanning, Isotopes in Medical Diagnosis, Doppler Monitor(colour), Medical imaging: X-ray generation, Image Intensifiers, Computer Aided Tomography, PET, SPECT, Laser Applications, Echocardiography, CT Scan MRI/ NMR, Endoscopy. | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**


1. Khandpur, "Handbook of Biomedical Instrumentation" 2nd Edition, Tata McGraw Hill, 2003.
2. Arumugam M, "Biomedical Instrumentation", Anuradha Publications, Reprint 2009.
3. Khandpur, Raghbir Singh, "Biomedical instrumentation: Technology and applications"2nd Edition, McGraw Hill, 2005.


**Reference Books**


1. Anandanatarajan, R, "Biomedical Instrumentation and Measurements", 2nd Edition, PHI Learning Pvt. Ltd., 2011.
2. Jog, NandiniK., "Electronics in Medicine and Biomedical Instrumentation", 2nd Edition, PHI Learning Pvt. Ltd., 2013.
3. Singh, Mandeep, "Introduction to biomedical instrumentation", 2nd Edition, PHI Learning Pvt. Ltd., 2014.
4. Leslie Cromwell, Fred J, Weibell & Erich A and P Feiffer, 'Biomedical Instr umentation and Measurements', 2nd Edition, PHI, 2011.
5. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.




Dr. L. M. Varalakshmi

**Web References**

1. ttps://wne.libguides.com/bme/websites
2. https://researchguides.dartmouth.edu/c.php?g=877404
3. https://www.google.com/search?client=firefox-b-d&q=nptel+bm
4. https://lecturenotes.in/subject/27/biomedical-instrumentation-bi/video
5. https://www.electrical4u.com/introduction-to-biomedical-instrumentation/

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | - | 1 | 1 | 2 | - | - | - | - | - | 1 | 2 | 1 | 1 |
| 2 | 3 | 2 | - | 1 | - | 2 | - | - | - | - | - | 1 | 2 | 1 | 1 |
| 3 | 3 | 2 | - | 1 | 1 | 1 | - | - | - | - | - | 1 | 2 | 1 | 1 |
| 4 | 3 | 2 | - | 1 | 1 | 2 | - | - | - | - | - | 1 | 2 | 1 | 1 |
| 5 | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | 1 | 2 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. L. M. Varalakshmi

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category : **PC** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICT712** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Logic and Distributed Control System** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | **Digital Logic Circuits, Control System** | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Understand working of PLC, I/O modules of PLC, automation and applications in industry. | **K2** |
| | **CO2** Acquire knowledge on the design of systems using PLC and PLC programming. | **K4** |
| | **CO3** Design and develop a PLC ladder programming for Simple Process Application | **K3** |
| | **CO4** Understand the fundamentals of DCS and its importance | **K2** |
| | **CO5** Gain expertise in SCADA system architecture and apply HMI concepts in real-world scenarios | **K3** |

| **UNIT- I** | **PLC Overview and Hardware Components** | **Periods:09** |
|---|---|---|
| Introduction - Principles of operation – PLC Architecture and specifications – PLC Versus computer- PLC size and application- PLC hardware components: Analog and digital I/O modules, CPU and memory module – Programming devices –Recording and retrieving data. | | **CO1** |
| **UNIT- II** | **PLC Programming** | **Periods:09** |
| PLC Programming language- Converting simple relay ladder diagram into PLC relay ladder diagrams - Latching instructions –modes of operation- programming timer and counters- program control instructions: MCR, JUMP and subroutines- data manipulation- Math Instruction- shift registers and sequencers. | | **CO2** |
| **UNIT- III** | **Applications of PLC** | **Periods:09** |
| Application of PLC –Continuous Filling operation using automatic conveyor system-control of traffic lights in two way directions-water level control in storage tank-flashing pilot light – set point temperature control-Converting Fahrenheit to Celsius. | | **CO3** |
| **UNIT- IV** | **Distributed Control System** | **Periods:09** |
| Evolution – Different architecture – Local control unit functions – Operator Interface – LLOI and HLOI - redundancy concepts – Displays – Communication networks and communications standards in DCS – Engineering Interface – Factors to be considered in selecting a DCS. | | **CO4** |
| **UNIT-V** | **Introduction to SCADA and HMI** | **Periods:09** |
| SCADA: - Hardware and software, Remote terminal units, Master station, Communication architectures and Open SCADA protocols.<br>HMI:- HMI Basics -Human Computer Interaction as an emerging field - Applications of Human Machine Interface (HMI) - HMI types - Human Information Processing -Interaction styles and general design | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**


1. Frank. D. Petrezuella, Programmable logic controllers, McGrewhill, Third edition, 2010.
2. Lucas. M.P., Distributed control systems, Van Nostrand and Reinhold company, NY,1986.
3. Hughes. T. Programmable controllers, ISA Press, 2000.


**Reference Books**


1. McMillan, G. K., Process Industrial Instrument and controls handbook, McGraw Hill, Newyork, 1999.
2. Berge.J., Field buses for process control: Engineering, operation and maintenance, ISA Press, 2004.
3. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP 3”, Summit Valley Press; 2nd edition, 2014.
4. Mikel P. Grover, et. Al. “Industrial Robots – Technology Programming and Applications”, McGraw Hill, 1980.
5. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw-Hill, 2004.




Dr. L. M. Varalakshmi

**Web References**

1. https://nptel.ac.in/courses/108105063/
2. https://www.google.com/amp/s/controlstation.com/what-is-a-distributed-control-system/amp/
3. https://nptel.ac.in/courses/108/105/108105088/
4. https://onlinecourses.nptel.ac.in/noc20_me39/preview
5. https://nptel.ac.in/content/syllabus_pdf/108105088.pdf.

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | - | 1 | 1 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 2 | 3 | 2 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 3 | 2 | 1 |
| 3 | 3 | 2 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 4 | 3 | - | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 1 | 2 |
| 5 | 2 | 1 | 1 | 2 | 1 | 1 | - | - | - | - | - | - | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



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| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category : **PC** | | | End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICP711** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Logic and Distributed Control System Laboratory** | **0** | **0** | **2** | **1** | **50** | **50** | **100** |

| Prerequisite | **Digital Logic Circuits, Control System** | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Understand the fundamentals and Programming of PLC | **K2** |
| | **CO2** Comprehend the concepts of functional block and instruction set in PLC programming. | **K2** |
| | **CO3** Design and implement control schemes in PLC | **K3** |
| | **CO4** Interface field devices with PLC | **K2** |
| | **CO5** Design and implement computer based control schemes for different processes | **K3** |

**List of Experiments**

1. Study of PLC field device interface modules (AI,AO,DI,DO modules )
2. Programming Logic Gates Function in PLC
3. Implementing Mathematical Operations, Timer, Counter operation using PLC
4. Programming Jump-to-subroutine and return operations in PLC
5. PLC Exercises: 1. Traffic Light Control and Bottle Filling Control Operation
6. PLC Exercises: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
7. Annunciator design using PLC
8. PLC based control of batch Process.
9. Study of Foundation Field bus /IOT/Wireless HART Enabled Transmitter.
10. Case study of DCS.(Distributed Control System)

| **Lecture Periods:-** | **Tutorial Periods:-** | **Practical Periods: 30** | **Total Periods:30** |
|---|---|---|---|

**Text Books**

1. Frank. D. Petrezuella, Programmable logic controllers, McGrewhill, Third edition, 2010.
2. Lucas. M.P., Distributed control systems, Van Nostrand and Reinhold company, NY,1986.
3. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP 3”, Summit Valley Press; 2nd edition, 2014.

**Web References**

1. https://nptel.ac.in/courses/108/105/108105063/.
2. https://nptel.ac.in/courses/112/102/112102011/.
3. https://www.youtube.com/playlist?list=PL874F91C0180417C3

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | - | 1 | 1 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 |
| 2 | 3 | 2 | 3 | 2 | 2 | 1 | - | - | - | - | - | - | 3 | 2 | 1 |
| 3 | 3 | 2 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 4 | 3 | - | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 1 | 1 | 2 |
| 5 | 2 | 1 | 1 | 2 | 1 | 1 | - | - | - | - | - | - | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | Performance in practical classes | | | Model Practical Examination | Attendance | | |
| | Conduction of practical | Record work | viva | | | | |
| Marks | 15 | 5 | 5 | 15 | 10 | 50 | 100 |



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| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category : **PC** | | | End Semester Exam Type**:LE** | | | |
| Course Code | **U23ICP712** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Technical Seminar** | **0** | **0** | **2** | **1** | **100** | **-** | **100** |

| Prerequisite | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
|---|---|---|---|
| **Course Outcomes** | **CO1** | Review, prepare and present technological developments. | K3 |
| | **CO2** | Face the placement interviews. | K3 |

**Method of Evaluation:**

- During the seminar session each student is expected to prepare and present a topic on engineering/technology, for duration of about 20 minutes.
- Ina session of three periods per week, 8 to10 students are expected to present the seminar.
- Each student is expected to present atleast twice during the semester and the student is evaluated based on that.
- At the end of the semester, he /she can submit a report on his/her topic of seminar and marks are given based on the report.
- A Faculty guide is to be allotted and he/she will guide and monitor the progress of the student and maintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.



| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category : **PC** | | | End Semester Exam Type:**LE** | | | |
| Course Code | **U23ICW703** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Project Phase I** | **0** | **0** | **4** | **2** | **50** | **50** | **100** |

| Prerequisite | **On completion of the course, the students will be able to** | |
|---|---|---|
| **Course Outcomes** | *After completion of the course, the students will be able to* | |
| | **CO1** Perceive the problems and to find suitable solutions. | **K5** |

**Description**

The students to work in groups of not more than four members in each group on a project involving analytical, experimental, design or combination of these in the area of Instrumentation and Control Engineering. Each project shall have an internal guide. The student is required to do literature survey, formulate the problem and form a methodology in arriving at the solution of the problem. The evaluation is based on internal review committee and guide for 50 marks. The End Semester Examination for the project work shall consist of an evaluation of the project report by an external examiner, followed by a viva-voce examination conducted by a committee consisting of the external examiner (25 marks) and an internal examiner (25 marks).

**CAM and ESM break-up for Project Phase-I**

| Sl. No | Description | | | Weightage |
|---|---|---|---|---|
| 1 | **Continuous Assessment Marks** | | | |
| a | Review1 | Review Committee | 10 | 15 |
| | | Supervisor | 5 | |
| b | Review2 | Review Committee | 10 | 15 |
| | | Supervisor | 5 | |
| c | Review3 | Review Committee | 15 | 20 |
| | | Supervisor | 5 | |
| | | | **Total CAM** | 50 |

| 2 | **End Semester Marks** | | | |
|---|---|---|---|---|
| | Evaluation of Phase I Report and Viva-voce | Report | 15 | 50 |
| | | Presentation and Viva | 20 | |
| | | Demonstration | 15 | |
| | | | **Total ESM** | 50 |
| | | | **Total Marks** | 100 |



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| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category: **PA** | | | *End Semester Exam Type: **LE** | | | |
| Course Code | **U23ICW704** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Internship/ Inplant Training** | **0** | **0** | **2** | **1** | **100** | **-** | **100** |
| Prerequisite | | | | | | | | |

Students may undergo Inplant training or internship during summer / winter vacation at Industry/ Research organization for a period of two weeks to four weeks. Students are also permitted to undergo internships during their seventh semester after the theory classes are over. Each student has to submit a detailed report on In-Plant Training which He / She have undergone. The department committee will assess the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of Inplant training or internship.

**Assessment method for Industrial Training/Internship**

| Assessment | **Continuous Assessment Marks (CAM)** | | Total Marks |
|---|---|---|---|
| | Report | Presentation | |
| Marks | 50 | 50 | 100 |

# Professional Elective Courses
# Semester – IV, V, VI

| Department | **Biomedical Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **PE** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23BMECO1** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Communication Systems** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| | (Common to BME and ICE) | | | | | | | |
| Prerequisite | Basic Electronics | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Understand the various Analog modulation techniques | **K2** |
| | **CO2** Gain knowledge in Digital modulation techniques | **K3** |
| | **CO3** Knowledge about fiber optic and satellite communication systems | **K2** |
| | **CO4** Analyse spread spectrum and multiple access techniques | **K3** |
| | **CO5** Realize the concepts of wireless communication | **K3** |

| **UNIT – I** | **Analog modulation** | **Periods:9** | |
|---|---|---|---|
| Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM –Power relation – Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers. | | | **CO1** |
| **UNIT – II** | **Digital modulation** | **Periods:9** | |
| Principles of pulse modulation – sampling theorem, PAM, PWM, PPM, Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction todigital modulation systems – PCM, DPCM, Delta Modulation, ADM, ASK, FSK and PSK. | | | **CO2** |
| **UNIT – III** | **Fiber optic and satellite communication** | **Periods:9** | |
| Need for fiber optics- principle of light transmission through a fiber- fiber classification-fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system - Power budget analysis for an optical link- Recent medical application of fiber optics.<br>Block diagram of a satellite communcation system, Satellite Orbits, satellite parameters, satellite link model, GPS services. | | | **CO3** |
| **UNIT – IV** | **Spread spectrum and multiple access techniques** | **Periods:9** | |
| Pseudo-noise sequence, DS spread spectrum, FH spread spectrum, multiple access techniques –TDMA andFDMA, source coding of speech for wireless communication. | | | **CO4** |
| **UNIT – V** | **Wireless communication** | **Periods:9** | |
| Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off- Introduction to 4G & 5G technologies | | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods:** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. Wayne Tomasi, “Advanced Electronic Communication Systems”, Sixth Edition, Pearson Education, 2010.
2. Kennedy Davis, “Electronic Communication Systems”, Fifth Edition, Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2011.
3. Rappaport T.S, "Wireless Communications: Principles and Practice", Second Edition, PearsonEducation, 2010.

**Reference Books**

1. Simon Haykin, “Communication Systems”, Fourth Edition, John Wiley and Sons, 2009.
2. William C.Y. Lee, “Mobile Cellular Telecommunication Systems”, McGraw Hill International Edition, Third edition, 2008.
3. H.Taub, D L Schilling and G Saha, “Principles of Communication”, Third Edition, Pearson Education,2010
4. B. P.Lathi, “Modern Analog and Digital Communication Systems”, Third Edition, Oxford University Press,2009
5. Martin S.Roden, “Analog and Digital Communication System”, Fifth Edition, Prentice Hall of India, 2012.

**Web References**

1. https://nptel.ac.in/courses/108104091/
2. https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/
3. https://nptel.ac.in/courses/117/105/117105143/
4. https://nptel.ac.in/courses/108104091/
5. https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
| 1 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | 3 | 1 | 1 | 2 | 2 | - |
| 2 | 3 | 2 | 2 | 1 | 2 | - | - | - | - | 3 | 1 | 1 | 2 | 2 | - |
| 3 | 3 | 3 | - | 1 | 1 | - | - | - | - | 3 | 1 | 1 | 2 | 2 | - |
| 4 | 3 | 2 | - | 1 | 1 | - | - | - | - | 3 | 1 | 1 | 2 | 2 | - |
| 5 | 3 | 3 | 2 | 1 | 2 | - | - | - | - | 3 | 1 | 1 | 2 | 2 | - |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **IV** | Course Category Code: **PE** | | | *End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICE401** | Periods / Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Energy Harvesting Techniques** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| ICE | | | | | | | | |
| Prerequisite | - | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Impart knowledge on the fossil fuels and alternate sources of energy. | **K2** |
| **CO2** | Comprehend the importance and applications of solar energy. | **K2** |
| **CO3** | Acquaint knowledge on the wind and geothermal energy harvesting technologies. | **K2** |
| **CO4** | Acquaint the concepts of ocean energy and hydro energy | **K2** |
| **CO5** | Interpret the characteristics of piezoelectric effect. | **K2** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Fossil Fuels and Alternate Sources of Energy** | **Periods:09** | |
| Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean, Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy, tidal energy, Hydroelectricity. | | | **CO1** |
| **UNIT – II** | **Solar Energy** | **Periods:09** | |
| Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking system. | | | **CO2** |
| **UNIT – III** | **Wind and Geothermal Energy Harvesting** | **Periods: 09** | |
| **Wind Energy:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.<br>**Geothermal Energy**: Geothermal Resources, Geothermal Technologies. | | | **CO3** |
| **UNIT – IV** | **Ocean Energy and Hydro Energy** | **Periods: 09** | |
| Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.<br>**Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources. | | | **CO4** |
| **UNIT – V** | **Piezoelectric Energy Harvesting** | **Periods: 09** | |
| **Piezoelectric Energy harvesting**: Introduction and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, piezoelectric parameters and modeling piezoelectric generators, piezoelectric energy harvesting applications. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**

1. G.D Rai, “Non-conventional energy sources”, Khanna Publishers, New Delhi, 2004.
2. Joseph Paradiso, "Energy Harvesting: Principles and Applications", MIT Press, 2008.
3. Brian C. Cullity, "Energy Harvesting: A Tutorial", IEEE Power Electronics Magazine, 2010.

**Reference Books**

1. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, Oxford University Press, in association with The Open University, 2004.
2. Dr. P Jayakumar, “Solar Energy: Resource Assessment Handbook”, Renewable Energy Corporation Network for the Asia Pacific, 2009.
3. J.Balfour, M.Shaw and S. Jarosek, “Photovoltaics”, Lawrence J Goodrich USA, 2011.
4. M P Agarwal, “Solar energy”, S Chand and Co. Ltd, 1985.
5. Suhas P Sukhative, “Solar energy”, Tata McGraw Hill Publishing Company Ltd., 1997.

**Web References**

1. https://www.electronicsforu.com/electronics-projects/electronics-design-guides/emerging-energy-harvesting-techniques-low-power-no-battery-solutions
2. https://onlinecourses.nptel.ac.in/noc19_me73/preview
3. https://www.youtube.com/watch?v=5kpqhLzRlns

4. https://www.mouser.in/applications/energy_harvesting/?srsltid=AfmBOoqDiqZhoaox2OfOjWGi0MMbwC3Hh9ZzuurBTrwe2iLSyvsn_kN_
5. https://proesolar.com/tips/solar-energy-harvesting/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| **2** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| **3** | 2 | 2 | - | - | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| **4** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| **5** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Engineering** | | | | | | | |
| Semester | **V** | Course Category Code: **PE** | | | *End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICE402** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Fundamentals of Computer Networks** | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| ICE | | | | | | | | |
| Prerequisite | Basics of computer hardware | | | | | | | |

| | | | |
|---|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Comprehend the role of network hardware and software, and different network models like OSI and TCP/IP. | **K2** |
| | **CO2** | Implement protocols like HDLC, PPP, Ethernet, and wireless LAN, and utilize techniques such as CSMA/CD and VLAN. | **K2** |
| | **CO3** | Utilize and differentiate between transport layer protocols, including TCP and UDP, for reliable data transmission. | **K2** |
| | **CO4** | Gain knowledge of email protocols like SMTP, POP3, IMAP, and MIME for various network communication services. | **K2** |
| | **CO5** | Understand and apply different network topologies such as bus, ring, star, mesh, and tree. | **K2** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Physical Layer** | **Periods:09** | |
| INTRODUCTION: Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet<br>THE PHYSICAL LAYER: Guided transmission media- twisted pair, co axial, fiber optics, wireless transmission. | | | **CO1** |
| **UNIT – II** | **Data Link Layer** | **Periods:09** | |
| Data Link Layer – Framing – Flow control – Error control – Data link layer Switching<br>Data Link Layer Protocols: HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN. | | | **CO2** |
| **UNIT – III** | **Network Layer and Transport Layer** | **Periods:09** | |
| Routing :RIP- LSRP-OSPF-BGP- internet protocol: IPv4 and IPv6 NETWORK LAYER protocols ARP,RARP, ICMP, DHCP<br>Transport layer protocols: UDP and TCP. | | | **CO3** |
| **UNIT – IV** | **Application Layer** | **Periods:09** | |
| Domain name system, Electronic mail, World Wide Web Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP | | | **CO4** |
| **UNIT – V** | **Network Topology and Networking Devices** | **Periods:09** | |
| Network Topology point-to-point- Bus- Ring -Star -Mesh –Tree Networking devices Hub. Switch Repeaters, Router. Bridge, Gateway, Modem, NIC | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**

1. A. S. Tanenbaum, Computer Networks, 4th edition, Pearson Education/PHI, New Delhi, India, 2003.
2. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 8th edition, Pearson Education, 2021.
3. Behrouz A. Forouzan, Data Communication and Networking, 4th edition, McGraw-Hill, India, 2006.

**Reference Books**

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, 5th edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, “Data and Computer Communications”, 10th edition, Pearson Education, 2013.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw-Hill, 2012.

**Web References**

1. https://osi-model.com/physical-layer/
2. https://ipcisco.com/lesson/network-devices-2/

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| **2** | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| **3** | 2 | 2 | - | - | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| **4** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| **5** | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **PE** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICE403** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Fundamentals of Pneumatics and Hydraulics** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | Basics in fluid mechanics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Acquire knowledge about the working of Pneumatic systems. | **K2** |
| | **CO2** Identify the controlling components of Pneumatic systems | **K3** |
| | **CO3** Comprehend the working of hydraulic systems | **K2** |
| | **CO4** Identify the controlling components of hydraulic systems | **K3** |
| | **CO5** Trouble shoot malfunctioning of the hydraulic and pneumatic systems and identifies the various application of the system. | **K3** |

| **UNIT – I** | **Introduction to Pneumatic Control** | **Periods:09** | |
|---|---|---|---|
| Structure of pneumatic control system.- Choice of working medium - characteristics of compressed air - Production of compressed air - Driers, filters, regulators, lubricators, distribution of compressed air. - Pneumatic Actuators: Linear cylinders – types, conventional type of cylinder working, mounting arrangements applications. | | | **CO1** |
| **UNIT – II** | **Directional Control Valves** | **Periods:09** | |
| Simple Pneumatic Control - Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves - speed control of cylinders supply air throttling - Exhaust air throttling and use of quick exhaust valve. Use of Logic gates – OR and AND gates pneumatic applications - Practical examples involving the use of logic gates. | | | **CO2** |
| **UNIT – III** | **Introduction to Hydraulic Systems** | **Periods:09** | |
| Structure of Hydraulic Control System - The Source of Hydraulic Power - Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps, Hydraulic Actuators - Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading. | | | **CO3** |
| **UNIT – IV** | **Hydraulic Motors** | **Periods:09** | |
| Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance, Control Components in Hydraulic Systems - Constructional features, pressure control valves – direct and pilot operated types, flow control valves. | | | **CO4** |
| **UNIT – V** | **Trouble Shooting and Applications** | **Periods:09** | |
| Trouble shooting and Remedies in Hydraulic and Pneumatic systems - Electrical and electronic components in fluid power systems (sensors, controllers). **Applications of Hydraulic and Pneumatic Systems** - Press and Forklift –**Low Cost Automation -** Hydraulic and pneumatic power packs. | | | **CO5** |
| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |

**Text Books**

1. Anthony Esposito, Fluid Power with applications, Pearson education, Inc., 5th Edition, 2000.
2. Andrew Parr, Pneumatics and Hydraulics, Jaico Publishing Co. 2000.
3. Dr. Niranjan Murthy and Dr.R.K. Hegde, Hydraulics and Pneumatics, Sa8\pna Publications, 2013.

**Reference Books**

1. Srinivasan. R, Hydraulic and Pneumatic Control, Tata McGraw - Hill Education, 2nd Edition, 2012.
2. Shanmugasundaram.K, Hydraulic and Pneumatic controls, Chand & Co, 2006.
3. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2011
4. Majumdar S.R., Oil Hydraulics Systems - Principles and Maintenance, Tata McGraw-Hill, 2001.
5. Majumdar, S.R., Pneumatic Systems – Principles and Maintenance, Tata McGraw Hill, 2007.

**Web References**

1. https://archive.nptel.ac.in/courses/112/106/112106300/#
2. https://www.youtube.com/watch?v=Dim0fLFIFOg
3. https://www.youtube.com/watch?v=lqgDDS7x1Gc

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | - | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 1 |
| 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 1 |
| 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 1 |
| 4 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 1 |
| 5 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category: **PE** | | | End Semester Exam Type: **TE** | | | * |
| Course Code | **U23ICE404** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Signal Processing for Instrumentation** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| | | ICE | | | | | | |

| Prerequisite | Basic Mathematics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Comprehend the continuous and discrete time signals and systems. | **K3** |
| | **CO2** Acquire knowledge on continuous time signal using fourier transform and laplace transform | **K3** |
| | **CO3** Analyze the frequency spectrum of discrete-time signals. | **K3** |
| | **CO4** Familiarize the concept of DFT and FFT. | **K3** |
| | **CO5** Acquaint knowledge on digital signal processor for various applications. | **K3** |

| **UNIT – I** | **Classification of Signals and Systems** | **Periods:09** |
|---|---|---|
| Continuous time signals, Discrete time signals, Representation of signals: Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential signals, Classification of continuous time and discrete time signals: Periodic, aperiodic and Random signals, Energy and power signals, Continuous time and discrete time systems: Classification of systems, Properties of systems. | | **CO1** |
| **UNIT – II** | **Analysis of Continuous Time Signals** | **Periods:09** |
| Fourier Series: Properties - Trigonometric and Exponential Fourier Series -Parsavel's relation for periodic signals - Fourier Transform: Properties - Laplace Transformation: Properties, R.O.C - Inverse Laplace transform. | | **CO2** |
| **UNIT – III** | **Analysis of Discrete Time Signals** | **Periods:09** |
| Discrete Time Fourier Series: Properties, Discrete Time Fourier Transform: Properties, Z Transformation: Properties, Inverse Z-Transformation. | | **CO3** |
| **UNIT – IV** | **Computation of DFT and FFT** | **Periods:09** |
| Discrete Fourier Transform (DFT), Relationship of the DFT to other transforms, Properties of DFT, circular convolution, filtering long duration sequences, parameter selection to calculate DFT. Computation of DFT using Fast Fourier Transforms (FFT) algorithm, DIT & DIF - FFT using radix 2 – Butterfly structure- FFT applications | | **CO4** |
| **UNIT – V** | **Digital Signal Processors** | **Periods:09** |
| Introduction – Architecture of one DSP processor for motor control – Features – Addressing Formats – Functional modes - Introduction to Commercial Processors. | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods:** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**

1. Allan V.Oppenheim, Allan S.Willsky and S.Hamid Nawab, "Signals and Systems", Pearson, Second Edition, New Delhi, 2015.
2. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
3. Proakis, J.G. and Manolakis, D.G., "Digital Signal Processing: Principles", Algorithms and Applications, Prentice Hall, 2007.
4. Rabiner, C.R. and Gold, B., "Theory and Applications of Digital Signal Processing", Prentice Hall of India Private Limited, 2000.

**Reference Books**

1. J Simon Haykins and Barry Van Veen, "Signals and Systems", Second Edition, Wiley, 2021.
2. H.P.Hsu and R.Ranjan, "Signals and Systems", Schaum's Outlines, Tata McGraw Hill, third Edition, 2013
3. Johny R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 2015.
4. J.GProakis and D.G.Manolakis, "Digital Signal Processing Principles", Algorithms and Applications, Pearson Education/ PHI, New Delhi, 2014.
5. Anil Jain K, "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2015.

**Web References**

1. http://eeweb.poly.edu/~onur/lectures/lectures.html.
2. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
3. https://nptel.ac.in/courses/117/105/117105079/
4. https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/
5. https://nptel.ac.in/courses/117101055

Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| **2** | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| **3** | 3 | 2 | 2 | 3 | 1 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| **4** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| **5** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 3 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **PE** | | | *End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICE505** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Calibration Systems** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

ICE

| Prerequisite | Basic Probability | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Comprehend the key terms related to testing and calibration | **K2** |
| | **CO2** Illustrate the test measurement instrumentation system. | **K2** |
| | **CO3** Determine the testing procedures for industrial instruments | **K2** |
| | **CO4** Summarize the procedures related to calibration requirements | **K2** |
| | **CO5** Interpret the calibration services of different laboratories | **K2** |

| **UNIT – I** | **INTRODUCTION TO TESTING AND CALIBRATION** | **Periods:09** | |
|---|---|---|---|
| The Signal Flow of Electronic Instruments, The Instrument Block Diagram, Measurement Systems, Types of instruments, Traceability, Calibration Types, Calibration Requirements, Calibration Methodology, Instrument Specifications and Calibration Tests, Calibration Standard Requirements.. | | | **CO1** |
| **UNIT – II** | **CALIBRATION STANDARDS** | **Periods:09** | |
| National Measurement Standard Laboratories, Commercial Calibration Services, Standards in different National Laboratories and Bureaus, calibration management and maintenance. | | | **CO2** |
| **UNIT – III** | **TESTING OF INSTRUMENTS** | **Periods:09** | |
| Voltage-Voltmeter, Current - Ammeter and Resistance - Ohmmeter, Temperature - Thermocouple, Pressure - Primary pressure sensing elements-Diaphragm, Bourdon tube**.** Flow – Pitot tube, Electromagnetic Flowmeter- Anemometer. | | | **CO3** |
| **UNIT – IV** | **CALIBRATION REQUIREMENTS** | **Periods:09** | |
| Calibration procedure, calibration procedure content, calibration datasheet, Instrument Specification Forms, Project Specifications, Manufacturers Specifications, Calibration Intervals, Safety Considerations, Calibration Status Labels. | | | **CO4** |
| **UNIT – V** | **INSTRUMENTATION AND DATA ANALYSIS** | **Periods:09** | |
| Test Measurement Instrumentation, Process Instrumentation, Test Objective – Requirements and limitations - Format and Analysis. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Henry Zumbrun" Force Calibration for Technicians and Quality Managers", 2024.
2. Vaisala Oyj, "Calibration Book", Calibration book project team, 2006.

**Reference Books**

1. Clyde F.Coombs Jr, "Electronic Instrument Handbook", Tata McH, 3rd Edition, 2008.
2. M/s. Beamex OYED, Fram in Vaasa, Finland, 2nd Edition, 2012.
3. Tony R. Kuphaldt, "Lesson in Industrial Instrumentation", 2017.

**Web References**

1. https://www.youtube.com/watch?v=SamV6zpRNgg
2. https://www.youtube.com/watch?v=RHt0sYsPUbw

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | - | - | 2 | 1 | 1 | - | - | - | - | - | 3 | - | 2 |
| 2 | 3 | 2 | - | 2 | 2 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |
| 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |
| 4 | 3 | 2 | 2 | - | 2 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |
| 5 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **PE** | | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23ICE506** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Industrial Unit Operations** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| ICE | | | | | | | | |
| Prerequisite | | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Determine unit operations, unit process and types of reactions involved in different industries | **K2** |
| | **CO2** Comprehend the unit operations in transportation of solids, liquids and gases | **K2** |
| | **CO3** Develop knowledge on the unit operations in different processes of distillation | **K2** |
| | **CO4** Outline the working principle and operation of different processes of Dryers, Crystallizers and Evaporators | **K2** |
| | **CO5** Analyze the unit operation in pumps compressors with case studies | **K3** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Overview of Unit Operations** | **Periods:09** | |
| Introduction to industrial processes - Concepts of unit operations and unit processes - Material balance and energy balance -Types of reactions - General idea of controlling operations. | | | **CO1** |
| **UNIT – II** | **Transport of Solids, Liquids and Gases** | **Periods:09** | |
| Study of Unit operation in Transport of Solids, liquids and gases - Different crushers and grinders - Adjusting of particle size, Mixing-Separation- Leaching and extraction. | | | **CO2** |
| **UNIT – III** | **Distillation, Chemical Reactors, Steam Boilers, Furnaces** | **Periods:09** | |
| Study of Unit operation in Distillation: Binary fractional distillation - Flash distillation - Batch distillation- Continuous distillation-Operational features- construction and working principle of Chemical reactors- Steam boilers- Furnaces | | | **CO3** |
| **UNIT – IV** | **Dryers, Crystallizers, Evaporator** | **Periods:09** | |
| Study of Unit operation in Dryers, Crystallization, Evaporators, Heat exchangers, Humidification, De-humidification - Different types - operational features, construction and working principle | | | **CO4** |
| **UNIT – V** | **Pumps, Compressors, Extruders, Blowers, Centrifuges** | **Periods:09** | |
| Study of Unit operation in Pumps, Compressors, Extruders, Blowers, Centrifuges - operational features, construction and working principle. **Case studies:** Unit Operations and Control schemes applied to Food processing Industry. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Balchen ,J.G., and Mumme, K.J., " Process Control structures and applications", Van Nostrand Reinhold Co., New York,1988
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, New York, 6th edition,2001.
3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical Process Equipment Selection and Design", Gulf Professional Publishing, 2010.

**Reference Books**

1. Waddams, A.L., "Chemicals from petroleum", Butler and Taner Ltd., UK,1969.
2. Liptak, B.G., "Process measurement and analysis", Chilton Book Company, USA,1995.
3. Luyben W.C., "Process Modeling, Simulation and Control for Chemical Engineers", McGraw- Hill, 5th edition, 2023.
4. McCabe, W.L., J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering". McGraw Hill. Inc. Kosaido Printing Ltd. Tokyo, Japan, 2001
5. Geankoplis C.J., Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi, 1999

**Web References**

1. https://www.youtube.com/watch?v=9M0HqQEFL6k
2. https://nptel.ac.in/courses/103107127/
3. https://www.docsity.com/en/ontroductions-unit-operations-lecture-slides/394376/

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | 3 | - | 2 |
| 2 | 3 | 3 | 2 | 3 | 1 | 1 | - | - | - | - | - | - | 3 | - | 3 |
| 3 | 3 | 3 | 2 | 3 | 1 | 1 | - | - | - | - | - | - | 3 | - | 3 |
| 4 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 3 | - | 3 |
| 5 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 3 | - | 3 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **PE** | | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23ICE507** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Instrumentation Buses and Data Networks** | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| ICE | | | | | | | | |
| Prerequisite | NIL | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Acquaint knowledge and analyze Instrumentation systems and their applications to various industries | **K2** |
| | **CO2** Determine basic concepts of data communication and its importance. | **K2** |
| | **CO3** Gain knowledge on the various internetworking devices involved in industrial networks. | **K2** |
| | **CO4** Explore the various serial communication used in process industries | **K2** |
| | **CO5** Illustrate and compare the working of HART and Field bus used in process digital communication. | **K2** |

| **UNIT – I** | **NETWORK FUNDAMENTALS** | **Periods:09** | |
|---|---|---|---|
| Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP | | | **CO1** |
| **UNIT – II** | **INTERNET WORKING and RS 232, RS485** | **Periods:09** | |
| Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Device net. | | | **CO2** |
| **UNIT – III** | **HART AND FIELD BUS** | **Periods:09** | |
| Introduction - Evolution of signal standard - HART communication protocol - HART networks HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability Interchangeability - Introduction to OLE for process control (OPC). | | | **CO3** |
| **UNIT – IV** | **MODBUS AND PROFIBUS PA/DP/FMS AND FF** | **Periods:09** | |
| MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation troubleshooting - review of foundation fieldbus - Data Highway. | | | **CO4** |
| **UNIT – V** | **INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION** | **Periods:09** | |
| Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100 | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, "Practical Industrial Data Networks: Design, Installation and Troubleshooting," Newnes Publication, Elsevier First Edition, 2004
2. Andrew Butterfield, "Industrial Automation Systems", Elsevier, 2017.
3. Michael J. Walsh, "Industrial Control Systems: A Practical Guide", CRC Press, 2016.

**Reference Books**

1. B.Govindarajulu, “IBM PC and CLONES”, Tata McGraw – Hill Publishing Company, 2004.
2. A. Behrouz Forouzan, “Data Communications & Networking”, 3rd Edition, Tata Mc Graw Hill, 2006.

**Web References**

1. https://nptel.ac.in/courses/106/105/106105082/.
2. https://lecturenotes.in/subject/903/industrial-data-networks-idn.

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | - | 2 | 1 | 1 | 2 |
| **2** | 3 | 2 | 3 | 2 | 1 | - | - | - | - | - | - | 2 | 2 | 1 | 2 |
| **3** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 2 | 2 | 1 | 2 |
| **4** | 2 | 2 | 2 | 3 | 1 | - | - | - | - | - | - | 2 | 2 | 1 | 2 |
| **5** | 3 | 2 | 2 | 3 | 1 | - | - | - | - | - | - | 2 | 2 | 1 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **V** | Course Category Code: **PE** | | | | End Semester Exam Type:**TE** | | |
| Course Code | **U23ICE508** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Instrumentation Symbols and Standards** | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| ICE | | | | | | | | |
| Prerequisite | NIL | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Comprehend the role of standards organization | **K2** |
| | **CO2** Implement different standards related to installation and control system, programming, documentation, equipment in hazardous area and instrument specification forms. | **K2** |
| | **CO3** Utilize standards related to control valve, actuators. orifice sizing, RTD and thermocouple | **K2** |
| | **CO4** Implement standards related to power plant and nuclear power plant. | **K2** |
| | **CO5** Build environment friendly electronic manufacturing systems. | **K2** |

| **UNIT – I** | **Standards Organization** | **Periods:09** | |
|---|---|---|---|
| Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI. API: Process Measurement and Instrumentation (APIRP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems. | | | **CO1** |
| **UNIT – II** | **ISA Standards** | **Periods:09** | |
| Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37) | | | **CO2** |
| **UNIT – III** | **ISA Standards - Control Valve and Actuator** | **Periods:09** | |
| Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24,75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04. | | | **CO3** |
| **UNIT – IV** | **Cybersecurity AD SIL Standards** | **Periods:09** | |
| Fossil Power Plant Standards - ISA62443, ISA84, IEC61508/61511 | | | **CO4** |
| **UNIT – V** | **BS , ISO, IEC, & ANSI** | **Periods:09** | |
| Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1). | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. W. Bolton, “Instrumentation and Control Systems”, Elsevier, 1st Edition, 2004.
2. Thomas A. Hughes, “Measurement and Control Basics”, ISA, 5th Edition, 2019.
3. William C. Dunn, “Industrial Instrumentation and Control Systems”, Artech House, 2nd Edition, 2005.

**Reference Books**

1. Roy D. Moffat, “Process Measurement and Control”, ISA, 2nd Edition, 2009.
2. Paul Gruhn and Harry L. Cheddie, “Safety Instrumented Systems: A Life-Cycle Approach”, ISA, 2nd Edition, 2006.
3. David W. Spitzer, “Fluid Flow Measurement: A Practical Guide to Accurate Flow Measurement”, ISA, 2nd Edition, 2005.

**Web References**

1. https://www.isa.org/standards-and-publications/isa-standards/isa-standards-committees/isa5-1
2. https://blog.ansi.org/ansi-isa-5-1-2024-instrumentation-symbols/

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 1 | 2 |
| **2** | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 2 | 1 | 2 |
| **3** | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 2 | 1 | 2 |
| **4** | 2 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 2 | 1 | 2 |
| **5** | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 2 | 1 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **V** | Course Category Code: **PE** | | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23ICE509** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Software Design Tools for Sensing and Control** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| ICE | | | | | | | | |
| Prerequisite | Mathematics | | | | | | | |

| Course Outcomes | On completion of the course, the students will be able to | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Select an appropriate software tool for sensor and actuator design. | **K2** |
| **CO2** | Design, model and simulate various sensing and actuating mechanisms. | **K3** |
| **CO3** | Design a controller and evaluate its performance through simulation. | **K3** |
| **CO4** | Design a controller using state space method and evaluate its performance through simulation. | **K3** |
| **CO5** | Acquire knowledge in the selection and usage of hardware for real time implementation of controllers. | **K2** |

| | | |
|---|---|---|
| **UNIT – I** | **Introduction to Sensor Design Software Tools** | **Periods:09** |
| Introduction to history of sensor design software tools, importance and need of software tools. Recent developments in sensor design and analysis software tools. Introduction to COMSOL Multiphysics. Structural Mechanics: Analysis of mechanical structures to static or dynamic loads. | | **CO1** |
| **UNIT – II** | **Software Tools for Sensor Design** | **Periods:09** |
| Stationary, transient, eigenmode/modal, parametric, quasi-static and frequency-response analysis. Electrical: AC/DC Module for simulating electric, magnetic, and electromagnetic fields in static and low frequency applications. Design and simulation of sensors and actuators using COMSOL. | | **CO2** |
| **UNIT – III** | **Software Tools for Micro Sensor Design** | **Periods:09** |
| Introduction to IntelliSuite, mechanism design, development of sensors and actuators. Introduction to Coventorware, Description of main modules, Architect, Designer, Analyzer and Integrator. System-level and physical-level design approaches. Introduction to meshing and result visualization. Design and simulation of sensors using Coventorware. | | **CO3** |
| **UNIT – IV** | **Software Tools for Control Design** | **Periods:09** |
| Introduction to MATLAB, Simulink and Scilab. Introduction to toolboxes. Control design problems using classical control. Control design problems using state space approach. | | **CO4** |
| **UNIT – V** | **Implementation of Controllers in Real Time** | **Periods:09** |
| Introduction to various hardware platforms, control design and implementation for electrical/mechanical/electromechanical/chemical processes using dSPACE, LabVIEW and OPAL-RT. | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**

1. Holly Moore, “MATLAB for Engineers”, Pearson Education, 5th edition, 2017.
2. Brian Hahn and Daniel Valentine, “Essential MATLAB for Engineers and Scientists”, Elsevier, Academic press, 6th edition, 2016.
3. Tamara Bechtold, Gabriela Schrag and Lihong Feng, “System-level Modeling of MEMS”, Wiley VCH verlag GmbH & Co, 1st edition, 2013.

**Reference Books**

1. Roger W. Pryor, “Multiphysics Modeling Using COMSOL: A First Principles Approach”, Jones and Bartlett Publishers, 1st edition, 2011.
2. Mehrzad Tabatabaian, “COMSOL 5 for Engineers”, Mercury Learning & Information, 1st edition, 2015.
3. S R Otto and J P Denier, “An Introduction to Programming and Numerical Methods in MATLAB”, Springer-verlag, 1st edition, 2005.
4. Stephen J Chapman, “MATLAB Programming for Engineers”, Bookware Companion Series, 5th Edition, 2015.
5. Amos Gilat, MATLAB, “An Introduction with Applications”, John Wiley & Sons, Inc., 5th edition, 2014.

**Web References**

1. https://www.comsol.com/
2. https://www.youtube.com/comsol
3. https://www.youtube.com/watch?v=h50L6UlW3a4&list=PLLii_xB37L998Ytf3hOGHFGbeTibm3U_c

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 2 | 3 | 1 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 3 | 3 | 1 | 3 | - | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 1 | 3 | - | - | - | - | - | - | - | - | - | 3 | 2 | 3 |
| 5 | 3 | 1 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VI** | Course Category Code: **PE** | | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23ICEC01** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Virtual Instrumentation** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

(Common to ICE and Mechatronics)

Prerequisite: -

| Course Outcomes | On completion of the course, the students will be able to | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Comprehend the concepts of virtual instruments | **K2** |
| **CO2** | Apply the Programming concepts in VI | **K3** |
| **CO3** | Interpret the concepts of instrument interfacing by VI tools. | **K2** |
| **CO4** | Acquaint the various instrument control interfaces. | **K2** |
| **CO5** | Elucidate the concepts of VI in real time applications. | **K2** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **INTRODUCTION** | **Periods:09** | |
| Evolution of LabVIEW - Block diagram and architecture of a virtual instrument – Graphical programming and comparison with conventional programming - Controls and indicators- Labels and Text –Shape, size and color – Data type, Format, Precision and representation – Data types – Data flow programming-Editing – Debugging and Running a Virtual Instrument. | | | **CO1** |
| **UNIT – II** | **PROGRAMMING STRUCTURE** | **Periods: 09** | |
| Front panel - Block diagram - VIS and sub-VIS, Display types – Digital – Analog – Chart – Oscilloscopic types, Loops: For Loops While Loops, arrays, clusters, Charts and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web. | | | **CO2** |
| **UNIT – III** | **DATA ACQUISITION** | **Periods: 09** | |
| Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements. | | | **CO3** |
| **UNIT – IV** | **INSTRUMENT CONTROL** | **Periods: 09** | |
| Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI. | | | **CO4** |
| **UNIT – V** | **APPLICATIONS** | **Periods: 09** | |
| Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**

1. Gupta , “Virtual Instrumentation Using Lab view”, 2nd edition, Tata McGraw-Hill Education, 2010
2. Jovitha Jerome, “Virtual Instrumentation using LabVIEW”, PHI Learning Pvt. Ltd., 2010.
3. T. S. Kang and D. M. Han, "Virtual Instrumentation: A Practical Approach", CRC Press, 2007.

**Reference Books**

1. Gary Jonson, “Labview Graphical Programming”, 4th edition, McGraw Hill, New York, 2012.
2. Gupta.S., Gupta.J.P., “PC interfacing for Data Acquisition and Process Control”, 2nd edition, Instrument Society of America, 2012.
3. Sokoloff; “Basic concepts of Labview 4”, Prentice Hall Inc., New Jersey 2013.
4. N. Mathivanan, "Virtual Instrumentation: Concepts and Applications", PHI Learning Private Limited, 2008.
5. Stephen T. Morse, "Virtual Instrumentation with LabVIEW: A Hands-On Guide", Prentice Hall, 2005.

**Web References**

1. https://www.ni.com/
2. https://www.youtube.com/user/Labview/playlists

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| 2 | 3 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | 1 |
| 3 | 2 | 2 | - | - | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| 4 | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| 5 | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VI** | Course Category Code: **PE** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICEC02** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Soft Computing Techniques** | **3** | **0** | **0** | **3** | 25 | 75 | 100 |

(Common to ICE and BME)

| Prerequisite | Basic Mathematics, Digital Circuits | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Illustrate the fuzzy sets and the properties of fuzzy logic | **K2** |
| | **CO2** Comprehend fuzzy logic controllers and its applications. | **K2** |
| | **CO3** Familiarize in the neural network architecture. | **K2** |
| | **CO4** Impart knowledge on various training algorithm of neural network and its application | **K2** |
| | **CO5** Interpret the concepts of optimization algorithms. | **K2** |

| **UNIT – I** | **Introduction to Fuzzy Logic** | **Periods:09** |
|---|---|---|
| Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations, linguistic variables, Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements. | | **CO1** |
| **UNIT – II** | **Fuzzy Logic Control System** | **Periods:09** |
| **Introduction to Fuzzy logic controller**: Architecture, Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification, Applications of Fuzzy logic controller. | | **CO2** |
| **UNIT – III** | **Introduction to Neural Network** | **Periods:09** |
| Introduction to neural networks, Biological neural networks, Artificial Neural network, Review of genetic algorithm- Single and Multi-layer feed forward network- Activation function, types (step and sigmoid function), threshold function, Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications. | | **CO3** |
| **UNIT – IV** | **Neural Networks Control** | **Periods:09** |
| Back propagation neural net: standard architecture and algorithm, Hopfield net: architecture and algorithm, Kohonnen's Self Organizing map, Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control, Applications of neuro controller. Case studies: Neuro controller for DC motor speed control, Neuro controller for a Temperature Process. | | **CO4** |
| **UNIT – V** | **Optimization** | **Periods:09** |
| Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Simulated Annealing – Random Search – Downhill Simplex Search. | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International, 4th editions, 2010.
2. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2008.
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA, 2015.

**Reference Books**

1. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 2019.
2. Rajasekaran. S, Pai. G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall, 2004.
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education, 2007.
4. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 2001.
5. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw Hill Education, 1st edition, 2017.

**Web References**

1. https://lecturenotes.in/subject/922.
2. https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf.
3. https://nptel.ac.in/courses/106/105/106105173/.

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | - | - | - | 2 | - | - | - | - | - | - | 3 | 2 | 1 |
| 2 | 3 | 3 | - | 3 | 3 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 3 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 4 | 3 | 2 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 5 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VI** | Course Category Code: **PE** | | | *End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICE610** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **MEMS and NEMS** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| ICE | | | | | | | | |
| Prerequisite | Linear Integrated Circuits | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Interpret the basics of micro / nano electromechanical systems. | **K2** |
| **CO2** | Recognize the use of materials in micro fabrication and describe the fabrication. | **K2** |
| **CO3** | Analyze the key performance aspects of electromechanical transducers. | **K3** |
| **CO4** | Comprehend the theoretical foundations of micro actuators. | **K2** |
| **CO5** | Analyze the efforts of Nano Devices. | **K3** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Introduction to MEMS and NEMS** | **Periods:09** | |
| Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals. | | | **CO1** |
| **UNIT – II** | **MEMS Fabrication Technologies** | **Periods:09** | |
| Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA. | | | **CO2** |
| **UNIT – III** | **Micro Sensors** | **Periods:09** | |
| MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester | | | **CO3** |
| **UNIT – IV** | **Micro Actuators** | **Periods:09** | |
| Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch. | | | **CO4** |
| **UNIT – V** | **Nano Devices** | **Periods:09** | |
| Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**

1. Marc Madou, “Fundamentals of Micro fabrication”, CRC press, 2009.
2. Stephen D. Senturia, “Micro system Design”, Kluwer Academic Publishers, 2001.
3. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata Mcraw Hill, 2012.

**Reference Books**

1. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006
2. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structuresll”, CRC Press, 2002.

**Web References**

1. https://ieeexplore.ieee.org/document/8352606.
2. https://www.theiet.org/publishing/inspec/researching-hot-topics/mems-to-nems/
3. https://nems.org/

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | - | - | - | 2 | - | - | - | - | - | - | 3 | 2 | 1 |
| 2 | 3 | 3 | - | 3 | 3 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 3 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 4 | 3 | 2 | 3 | 3 | 3 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |
| 5 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 2 | 1 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VI** | Course Category Code: **PE** | | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23ICE611** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Non-Linear control systems** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| ICE | | | | | | | | |
| Prerequisite | Mathematics, Control System | | | | | | | |

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Apply advanced control theory to practical engineering problems | **K2** |
| **CO2** | Design in state space analysis | **K2** |
| **CO3** | Interpret the stability of linear and nonlinear systems using Lyapunov method. | **K2** |
| **CO4** | Design of digital controller. | **K3** |
| **CO5** | Describe the discrete system design stability concept | **K2** |

| **UNIT – I** | **State Space Model** | **Periods:09** | |
|---|---|---|---|
| Introduction to State Space, State Variables, Physical Variables, Phase Variables-Matrices, Eigen Values and Eigen vectors - Diagonalization, Canonical and Jordan forms - State Space Models from Differential Equations - Conversion of State Variable Models to Transfer Function. | | | **CO1** |
| **UNIT – II** | **Mathematical Analysis** | **Periods:09** | |
| Computation of State Transition Matrix - Laplace Transformation Method, Canonical Transformation - Cayley Hamilton Theorem- Solution of State Equation. Concepts of Controllability and Observability | | | **CO2** |
| **UNIT – III** | **Phase Plane Analysis** | **Periods:09** | |
| Features of linear and non-linear systems - Common physical non-linearity – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method. | | | **CO3** |
| **UNIT – IV** | **Describing Function Analysis** | **Periods:09** | |
| General Properties of Non-Linear Systems - Describing Function Method - On / Off, Dead Zone, Saturation and Hysteresis Non Linearity - Determination of Limit Cycle by Describing Function. Stability of oscillations | | | **CO4** |
| **UNIT – V** | **Stability Analysis** | **Periods:09** | |
| Stability concepts - Equilibrium points - BIBO and asymptotic stability, Lyapunov Theory, Definitions (Stability and Functions). Direct method of Lyapunov, Application to non-linear problems.Stability analysis by describing function method –jump resonance. Frequency domain stability criteria. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**

1. Benjamin C. Kuo, “Digital Control Systems”, Oxford University Press, 10th Edition 2018.
2. George J. Thaler, “Automatic Control Systems”, Jaico Publishers, 2013.
3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 1st Edition, 2006.

**Reference Books**

1. Nagrath I J and Gopal M, “Control System Engineering”, New Age International Pvt Ltd, 6th Edition, 2017.
2. Smarajith Ghosh, “Control Systems Theory and Applications II”, Pearson Education, Singapore, 6th Edition, 2015.
4. K. Ogata, “Modern Control Engineering”, Prentice Hall of India Pvt. Ltd., PHI, New Delhi, 2015.
5. William S Levine, “Control System Fundamentals”, The Control Handbook, CRC Press, Tayler and Francies Group, 2nd Edition, 2011.
6. D.S.Naidu, “Optimal Control Systems” First Indian Reprint, CRC Press, 1st Edition, 2009.

**Web References**

1. https://lecturenotes.in/subject/111/advanced-control-systems-acs
2. https://nptel.ac.in/courses/108103007/
3. https://freevideolectures.com/course/3488/advanced-control-systems

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 3 |
| 2 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | - | 2 | 2 | 3 |
| 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 2 | 2 | 3 |
| 4 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | 3 |
| 5 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VI** | Course Category Code: **PE** | | | *End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICE612** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Piping and Instrumentation Diagram** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| | | ICE | | | | | | |

| | | | |
|---|---|---|---|
| Prerequisite | Industrial Instrumentation, Control System | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Comprehend the basics of piping and instrumentation diagrams | **K2** |
| | **CO2** | Impart knowledge on P&I D symbols for pumps, compressors and process vessels. | **K2** |
| | **CO3** | Implement the control concepts in basic process systems and develop simple control loops | **K3** |
| | **CO4** | Impart knowledge to development the piping on P&IDs | **K2** |
| | **CO5** | Develop the safety interlock systems and alarm systems in process plants and P&ID systems. | **K3** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Introduction to Piping and Instrumentation Diagrams** | **Periods:09** | |
| Introduction to P&ID - Importance of P&IDs -Common tools used to develop P&IDs-General guidelines for developing P&IDs -Types of P&IDs - Steps in developing P&IDs - Comparison of BFD, PFD, and P&IDs. | | | **CO1** |
| **UNIT – II** | **Piping and Instrumentation Diagram Evaluation and Preparation** | **Periods:09** | |
| P & I D Symbols, line numbering, line schedule, P&I D development, various stages of P&I D, P&I D for pumps, compressors process vessels, Heat exchanger, Storage tanks. | | | **CO2** |
| **UNIT – III** | **Control Systems Components for Process Operation** | **Periods:09** | |
| Introduction and description, Valve types , P&IDs for furnaces or heaters, distillation column, Flow measurement and restriction , Gauges and switches, Cascade process controls, | | | **CO3** |
| **UNIT – IV** | **Development of Piping on P&IDs** | **Periods:09** | |
| Introduction to piping, Significance of piping, Pipeline tagging and information, Selection of piping specification and guidelines, Selection of piping class, Smart plant 3D. | | | **CO4** |
| **UNIT – V** | **Plant Interlocks, Alarms and P&ID systems** | **Periods:09** | |
| Safety Instrumented Functions on P&IDs- Process alarms - Safety interlocks -. Control valve stations - Reactor system - Storage tank mixer and heater - P&IDs for boilers - Storage tank with a pump system | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**

1. Avinashkumar Vinodkumar Karre, “Piping and Instrumentation Diagram.” CPI books Walter de Gruyter GmbH, Berlin/Boston, 2023.
2. Max. S. Peters and K.D.Timmerhaus, “Plant Design and Economics for Chemical Engineers”, McGraw Hill Inc., New York, 1991.
3. Considine, John M., "Piping and Instrumentation Diagrams: A Practical Guide", McGraw-Hill, 2009.

**Reference Books**

1. Anil Kumar, “Chemical Process Synthesis and Engineering Design”, Tata McGraw Hill, New Delhi, 1981.
2. A.N.Westerberg et al., “Process Flow sheeting”, Cambridge University Press, New Delhi, 1979.
3. Moe Toghraei, “Piping and Instrumentation Diagram Development”, 1st Edition, Wiley-Blackwell, USA, 2019.
4. Anderson, James G., "Piping and Instrumentation Diagrams: A Practical Guide to Design, Layout, and Application", Prentice Hall, 2014.
5. Stephanopoulos, George, "Process Control Engineering", Prentice Hall, 1984.

**Web References**

1. https://www.youtube.com/watch?v=2VLpV1dpUho
2. https://www.youtube.com/watch?v=aWGlXamTRd4

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 3 | - | 2 |
| 2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |
| 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |
| 5 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | 3 | - | 3 |

**Correlation Level: 1-Low, 2-Medium, 3- High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

## Professional Elective

| Professional Elective – IV (Offered in Semester VII) | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | U23ICEC03 | Intelligent Robotic Systems |
| 2 | U23ICE713 | Computer Control of Processes |
| 3 | U23ICE714 | Fiber Optics and Laser Instrumentation |
| 4 | U23ICE715 | Instrumentation in Process Industries |
| 5 | U23ICE716 | Safety Instrumented System |

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category: **PE** | | | *End Semester Exam: **TE** | | | |
| Course Code | **U23ICEC03** | Periods/Week | | | Credit | Maximum Marks | | |
| | | **L** | **T** | **P** | **C** | **CAM** | **ESE** | **TM** |
| Course Name | **Intelligent Robotic Systems** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| (Common to ICE and ECE) | | | | | | | | |
| Prerequisite | **Basics of Electronics and Control** | | | | | | | |

| | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
|---|---|---|---|
| **Course Outcome** | **CO1** | Understand the fundamental concepts and structure of robotic systems. | **K2** |
| | **CO2** | Identify and analyze various sensors, actuators, and perception systems used in robotics. | **K2** |
| | **CO3** | Impart knowledge on control techniques and path planning algorithms for robot motion and navigation. | **K2** |
| | **CO4** | Interpret AI and ML techniques in robotics, including reinforcement learning and SLAM. | **K3** |
| | **CO5** | Acquaint knowledge on advanced robotics applications and assess ethical considerations in human-robot interactions. | **K3** |

| **UNIT-I** | **Introduction to Robotics** | **Periods:09** |
|---|---|---|
| History of robotics, evolution of robotics, Classification, Anatomy, links, joints, and degrees of freedom (DOF), mechanical structure of robotic systems Kinematics and Dynamics, Trajectory Planning | | **CO1** |
| **UNIT-II** | **Sensors, Actuators, and Perception** | **Periods:09** |
| **Sensors**: Proximity sensors, Tactile sensors, Vision sensors, IMU (Inertial Measurement Unit), GPS, and LIDAR. Actuators**,** DC motors, servo motors, stepper motors, hydraulic actuators, and pneumatic actuators -robotic motion. **Sensor Fusion:** Calibration, Vision-Based Perception | | **CO2** |
| **UNIT-III** | **Control and Path Planning** | **Periods:09** |
| **Control Systems**: PID control, adaptive control, and Nonlinear control- (Sliding Mode Control (SMC)). Path Planning, Techniques like A*, Dijkstra's algorithm, probabilistic roadmaps (PRM), and rapidly-exploring random trees (RRT). Obstacle Avoidance, Trajectory Tracking implementation. | | **CO3** |
| **UNIT-IV** | **Artificial Intelligence and Machine Learning in Robotics** | **Periods:09** |
| AI in Robotics, Machine Learning, Supervised learning, SVM, Random Forest and unsupervised learning, K-mean clustering, PCA, Reinforcement Learning Deep Q-Networks (DQN)**, SLAM**: Simultaneous Localization and Mapping (SLAM) | | **CO4** |
| **UNIT-V** | **Advanced Robotics and Human-Robot Interaction** | **Periods:09** |
| Multi-Robot Systems, Human-Robot Interaction, Ethics, Case Studies**,** Real-world applications in autonomous vehicles, industrial robots, and medical robots are discussed to pr ovide practical insights into intelligent robotics. | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods: -** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Textbooks**


1. John J. Craig, “Introduction to Robotics: Mechanics and Control”, 4th Edition, 2018.
2. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics: Control, Sensing, Vision, and Intelligence”, 1st Edition, 1987.
3. Sebastian Thrun, Wolfram Burgard and Dieter Fox, “Probabilistic Robotics”, 1st Edition, 2005.
4. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 4th Edition, 2020.
5. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, “Robot Modeling and Control”, 1st Edition, 2005.


**Reference Books**


1. Nikolaus Correll, Bradley Hayes, and Bradley Pierson, “Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms”, 3rd Edition, 2022.


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2. Kevin M. Lynch and Frank C. Park, "Modern Robotics: Mechanics, Planning, and Control", 1st Edition, 2017.
3. Bruno Siciliano and Oussama Khatib, "Springer Handbook of Robotics", 2nd Edition, 2016.
4. Peter Corke, Robotics, "Vision and Control: Fundamental Algorithms in MATLAB", 2nd Edition, 2017.
5. Lentin Joseph, "Learning Robotics using Python", 2nd Edition, 2018.

**Web References**

1. https://onlinecourses.nptel.ac.in/noc24_me117/preview
2. https://archive.nptel.ac.in/courses/112/107/112107289/
3. https://onlinecourses.nptel.ac.in/noc22_cs97/preview
4. https://www.coursera.org
5. https://www.ros.org

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| **1** | 2 | 1 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **2** | 2 | 1 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **3** | 2 | 1 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **4** | 2 | 1 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |
| **5** | 2 | 1 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 3 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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| Department | **Instrumentation and Control Engineering** | Programme : **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category Code: **PE** | | | *End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICE713** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Computer Control of Processes** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| Prerequisite | **Process Control** | | | | | | | |

| **Course Outcomes** | ***On completion of the course, the students will be able to*** | **BT Mapping (Highest Level)** |
|---|---|---|
| | **CO1** Gain knowledge on the discrete time systems. | **K2** |
| | **CO2** Describe the transient and steady state behaviours of linear discrete time control systems. | **K2** |
| | **CO3** Design a digital controller. | **K4** |
| | **CO4** Understand the concept of MIMO Controller. | **K2** |
| | **CO5** Understand basic principles and importance of Multivariable Control Systems. | **K2** |

| **UNIT-I** | **Introduction to Computer Control System** | **Periods: 09** |
|---|---|---|
| Need for computer in a control system, Building blocks of a computer control system, Representation and analysis of Sampled data control systems, Zero Order Hold and First Order Hold, Sampling Theorem- Controllability and observability of linear time invariant discrete data system, stability analysis: Jury's test and bilinear transformation. | | **CO1** |
| **UNIT-II** | **System Modeling and Discrete-Time Analysis** | **Periods: 09** |
| Mathematical model for processes, first order. Second order processes without and with pure delay higher order systems, process modeling from step test data. Review of z-transform, Modified z-transform, Pulse transfer function, Digital PID controller. | | **CO2** |
| **UNIT-III** | **Digital Controller Design** | **Periods: 09** |
| Design for Set point and load changes: Dead-beat control, Dahlin's control and Kalman's control, ringing phenomenon in digital controller, selection of sampling time. | | **CO3** |
| **UNIT-IV** | **Multi-Loop Regulatory Control** | **Periods: 09** |
| Multi-loop Control, Introduction, Process Interaction, Pairing of Inputs and Outputs, The Relative Gain Array (RGA), Properties and Application of RGA, Multi, loop PID Controller, Biggest Log Modulus Tuning Method, De coupler. | | **CO4** |
| **UNIT-V** | **Multivariable Regulatory Control** | **Periods:09** |
| Introduction to Multivariable control, Multivariable PID Controller, Multivariable Dynamic Matrix Controller, Case Study: Distillation Column: Temperature, CSTR: Flow Rate. | | **CO5** |

| **Lecture Periods: 45** | **Tutorial Periods:-** | **Practical Periods: -** | **Total Periods: 45** |
|---|---|---|---|

**Text Books**


1. Gopal,M. ,"Digital Control and State Variable Methods", Tata Mc Graw Hill, Fourth Edition, 2017.
2. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2015.
3. M. Chidambaram, Computer control of process, Narosa publishing house, 2015.


**Reference Books**


1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 2015.
2. Donald R.Coughnowr, Process Systems Analysis and Control, Mc-Graw Hill Education, Third Edition, 2009.
3. E. Ikonen and K.Najim, "Advanced Process Identification and Control", Marcel Dekker, Inc.Newyork, 2002.
4. C.D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2013.
5. C.L. Smith, Digital Computer Process Control, Intext Educational Publishers, 2007.


**Web References**

1. https://nptel.ac.in/courses/112/105/112105211/
2. https://www.youtube.com/watch?v=ImtSsDLgAaI&feature=emb_logo
3. https://automationforum.co/
4. https://www.youtube.com/watch?v=i_2Vawly0iA
5. https://www.youtube.com/watch?v=Pa-vd6E0kLo

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**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 3 | 3 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 4 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 3 | 3 | 3 |
| 5 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | - | - | - | 3 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Internal Assessment Marks (IAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |



Dr. L. M. Varalakshmi

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
| Semester | **VII** | Course Category Code: **PE** | | | End Semester Exam Type: **TE** | | | |
| Course Code | **U23ICE714** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Fiber Optics and Laser Instrumentation** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| | | | |
|---|---|---|---|
| Prerequisite | Engineering physics | | |
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Elucidate the basic concepts of optical fibers and their properties | **K2** |
| | **CO2** | Understand the effect of optical source, detectors and sensors | **K2** |
| | **CO3** | Explore the laser fundamentals and different types of laser | **K2** |
| | **CO4** | Acquire knowledge on industrial application of lasers. | **K2** |
| | **CO5** | Understand hologram and its medical applications. | **K2** |

| | | | |
|---|---|---|---|
| **UNIT – I** | **Introduction to Fiber Optics** | **Periods:09** | |
| Principles of light propagation through a fiber - Basic optical laws and definitions - Different types of fibers and their properties, fiber characteristics – Wave Propagation-Fiber Losses– Dispersion – Connectors and splicers. | | | **CO1** |
| **UNIT – II** | **Optical Sources, Detectors and Sensors** | **Periods: 09** | |
| Optical sources-LED characteristics -LED structures: surface LED, edge emitting LED-Double heterojunction LED-Basic concepts of Laser. Optical Detectors: PN Photo diode , Avalanche photo diode ,PIN diode, Photo transistor ,Photo thyristors ,Photo thermistor, opto-couplers ,optrodes, modulators. Fibre optic sensors - Fiber optic instrumentation system - Interferometric method of measurement of length - Moire-fringes - Measurement of pressure and temperature-Case study -Terahertz application in 5G. | | | **CO2** |
| **UNIT – III** | **Laser Fundamentals** | **Periods: 09** | |
| Laser Diode Rate Equation - External Quantum Efficiency- Resonant Frequencies - Three level and four level lasers - Properties of laser -Laser modes - Resonator configuration - Q-switching and mode locking - Cavity damping- Types of lasers - Gas lasers, Solid lasers, Liquid lasers, Semiconductor lasers, Non-semiconductor lasers- The Nd:YAG laser and glass fiber lasers | | | **CO3** |
| **UNIT – IV** | **Industrial Application of Lasers** | **Periods: 09** | |
| Laser for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect - material processing - Laser heating, welding, melting and trimming of materials - Removal and vaporization. | | | **CO4** |
| **UNIT – V** | **Hologram and Medical Applications of Lasers** | **Periods: 09** | |
| Holography - Basic Principle - Methods - Holographic interferometry and applications, Holography for non destructive Testing - Medical Applications of Lasers, Lasers and Tissue interaction - Laser Instrumentations for surgery, Removal of Tumours of Vocal cords, Brain surgery, Plastic surgery. Safety methods for medical lasers. | | | **CO5** |

| | | | |
|---|---|---|---|
| **Lecture Periods:45** | **Tutorial Periods:** | **Practical Periods:-** | **Total Periods:45** |

**Text Books**


1. Djafar.K. Mynbaev, Lowell. Scheiner, Fiber-Optic Communications Technology, Pearson Education Pvt. Ltd., 1st Edition, 2008.
2. John M Senior, Optical Fiber Communications: Principles and Practice, 3rd Edition, 2010.
3. R.P. Khare, Fiber optics & optoelectronics, Oxford University Press, 2016.


**Reference Books**


1. Wilson and Hawkes, Opto Electronics - An Introduction, Prentice Hall, New Delhi, 3rd Edition, 2003.
2. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2013.
3. Eric Udd, William B., and Spillman, Jr., Fiber Optic Sensors: An Introduction for Engineers and Scientists, John Wiley & Sons, 2011.
4. Bela.G.Liptak, “Process Control and Optimization”, Instrument Engineers’ Handbook, volume 2,CRC. 2018
5. R.P. Khare, Fiber optics & optoelectronics, Oxford University Press, 2016.


**Web References**

1. https://www.photonics.com/Articles/Fiber_Optics_Understanding_the_Basics/a25151
2. https://www.me.iitb.ac.in/~gandhi/me645/05L11_laserprinciples.pdf
3. https://electricalengineeringx.com/what-is-optoelectronics-its-fields-components-and-applications/
4. https://cnj.atu.edu.iq/wp-content/uploads/2020/03/CHAP6-ATU-2018.pdf
5. https://www.elprocus.com/diffrent-types-of-fiber-optic-sensors/

* TE – Theory Exam, LE – Lab Exam

Dr. L. M. Varalakshmi

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | - | - | 1 | - | - | - | - | - | - | 3 | 2 | 2 |
| 2 | 3 | - | - | - | - | 1 | - | - | - | - | - | - | 3 | 1 | 2 |
| 3 | 3 | - | - | - | - | 1 | - | - | - | - | - | - | 3 | 2 | 3 |
| 4 | 3 | 3 | 3 | - | - | 1 | - | - | - | - | - | - | 3 | 1 | 3 |
| 5 | 3 | 2 | 1 | 1 | - | 1 | - | - | - | - | - | - | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Methods**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus



Dr. L. M. Varalakshmi

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category : **PE** | | | End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICE715** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Instrumentation in Process Industries** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | **Process Control** | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Explain the basic operation of various industries. | **K2** |
| | **CO2** Summarize the process parameters with appropriate sensors/transducers in paper industry. | **K2** |
| | **CO3** Explain the measurement of different process parameters for petrochemical industries. | **K2** |
| | **CO4** Analyze the working of different Instruments used in specified industries. | **K3** |
| | **CO5** Compare diverse measurement techniques/control of process parameters. | **K2** |

| **UNIT- I** | **Overview of Industrial Processes** | **Periods:09** |
|---|---|---|
| Description of process in Paper Industries Description of process in petrochemical industries: Description of process in iron and steel and cement industries - Description of process in pharmaceutical and nuclear industries. | | **CO1** |
| **UNIT- II** | **Instrumentation in Paper Industries** | **Periods:09** |
| Measurement of Basic weight, thickness, density, Porosity, smoothness, softness, hardness and compressibility; selection of suitable measurement hardware for flow, pressure, level, temperature, density, solids, consistency - moisture analyzers oxidation - reduction potential and pH. | | **CO2** |
| **UNIT- III** | **Instrumentation in Petrochemical Industries** | **Periods:09** |
| measurement and control of absolute pressure, density, conductivity, differential pressure and flow of evaporators. Measurement and control of column pressure, liquid distillate, vapour distillate P & I diagram of petroleum refinery | | **CO3** |
| **UNIT- IV** | **Instrumentation in Iron and Steel Industries** | **Periods:09** |
| **Iron and steel**: Selection of suitable measurement hardware for temperature, pressure, level, flow, weighing and proportioning - special gauges for measurement of thickness and shape. | | **CO4** |
| **UNIT-V** | **Instrumentation in Pharmaceutical Industries** | **Periods:09** |
| **Pharmaceutical Industries:** Flow measurement - pressure measurement - smoke detector. | | **CO5** |

**Lecture Periods:45** **Tutorial Periods:-** **Practical Periods:-** **Total Periods:45**

**Text Books**


1. B.G. Liptak, “Instrumentation Engineers Handbook (Measurement)”, Fourth Edition, Volume 1, CRC press, 2011.
2. Gregory K. McMillan's Considine D. M., “Process/Industrial Instruments and Control Handbook”, McGraw Hill, 5th edition 2009.
3. Norman A. Anderson, “Instrumentation for Process Measurement and Control”, Routledge, Third Edition, 2017.


**Reference Books**


1. Liptak B G, “Instrument Engineer’s Handbook, Vol. 2: Process Control and Optimization”, CRC Press, 2006.
2. BhaskaraRao, “a text on petrochemicals”, Trendy paper, 2004.
3. Liptak B.G, “Process Measurement and Analysis”, Third Edition, Chilton Book Co., 2003.
4. William G. Andrew and H.B. Williams, "Applied Instrumentation in the Process Industries: Volume 3, Engineering Data and Resource Manual," Gulf Professional Publishing, 3rd Edition, 1993.
5. S.K. Singh, "Industrial Instrumentation and Control," Tata McGraw-Hill Education, 3rd Edition, 2009.


**Web References**

1. https://www.branom.com/instruments-type.html
2. https://www.controlengeurope.com/features/132/Process-instrumentation/
3. https://new.siemens.com/global/en/products/automation/process-instrumentation.html
4. https://archive.org/details/appliedinstrumen0001andr?utm_source=chatgpt.com
5. https://www.accessengineeringlibrary.com/browse/fundamentals-of-industrial-instrumentation-and-process-control-second-edition?utm_source=chatgpt.com

Dr. L. M. Varalakshmi

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | 3 | 2 | 3 | 2 | - | 3 | 1 | - | - | 3 | 3 | 3 | 3 |
| 2 | 3 | 2 | 3 | 2 | 3 | 2 | - | 3 | 1 | - | - | 3 | 3 | 3 | 3 |
| 3 | 3 | 2 | 3 | 2 | 3 | 1 | - | 3 | 1 | - | - | 3 | 3 | 3 | 3 |
| 4 | 3 | 2 | 3 | 2 | 3 | 2 | - | 3 | 1 | - | - | 3 | 3 | 3 | 3 |
| 5 | 3 | 2 | 3 | 2 | 3 | 1 | - | 3 | 1 | - | - | 3 | 3 | 3 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Dr. L. M. Varalakshmi

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech.** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VII** | Course Category : **PE** | | | End Semester Exam Type:**TE** | | | |
| Course Code | **U23ICE716** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Safety Instrumented System** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

| Prerequisite | **-** | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Analyse the role of safety instrumented systems in the industry. | **K2** |
| | **CO2** Identify and analyse the hazards. | **K2** |
| | **CO3** Determine the safety integrity level for an application. | **K3** |
| | **CO4** Analyse the failure modes, failure rates and MTBF using various reliability engineering tools. | **K3** |
| | **CO5** Apply the design, installation and maintenance procedures for SIS applied to industrial processes. | **K3** |

| **UNIT- I** | **Introduction of Safety Instrumented System** | **Periods:09** | |
|---|---|---|---|
| Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS - Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions - Standards and Regulation – HSE-PES, AICHE-CCPS, IEC-61508, ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996, NFPA 85, API RP 556, API RP 14C, OSHA (29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals – SIS design cycle - Process Control vs. Safety Control. | | | **CO1** |
| **UNIT- II** | **Protection Layers And Safety Requirement Specifications** | **Periods:09** | |
| Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, Procedures, Shutdown/Interlock/Instrumented Systems (Safety Instrumented Systems – SIS), Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards. | | | **CO2** |
| **Unit- III** | **Safety Integrity Level** | **Periods:09** | |
| Evaluating Risk, Safety Integrity Levels, SIL Determination Method: As Low as Reasonably Practicable (ALARP), Risk matrix, Risk Graph, Layers of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing. | | | **CO3** |
| **UNIT- IV** | **System Evaluation** | **Periods:09** | |
| Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modeling Accuracy, Modeling Methods: Reliability Block Diagrams, Fault Trees, Markov Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities. | | | **CO4** |
| **UNIT-V** | **Case study** | **Periods:09** | |
| SIS Design checklist - Case Description: Furnace/Fired Heater Safety Shutdown System: Scope of Analysis, Define Target SILs, Develop Safety Requirement Specification (SRS), SIS Conceptual Design, Lifecycle Cost Analysis, verify that the Conceptual Design Meets the SIL, Detailed Design, Installation, Commissioning and Pre-start-up Tests, Operation and Maintenance Procedures. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**


1. Lucchini, S., Gruhn, P. “Safety Instrumented Systems: A Life-cycle Approach”, United States: International Society of Automation, 2019.
2. Paul Gruhn and Harry L. Cheddie, “Safety Instrumented Systems: Design, Analysis and Justification”, ISA, 2nd edition, 2018.
3. Eric W. Scharpf, Heidi J. Hartmann, Harold W. Thomas, “Practical SIL Target Selection: Risk Analysis per the IEC 61511 Safety Lifecycle, Exida”, 2nd edition, 2016.
4. William M. Goble and Harry Cheddie, “Safety Instrumented Systems Verification: Practical Probabilistic Calculations”, ISA, 2005.
5. Edward Marszal, Eric W. Scharpf, “Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis”, ISA, 2002.


Dr. L. M. Varalakshmi

**Reference Books**


1. David J. Smith, *"Reliability, Maintainability and Risk: Practical Methods for Engineers"*, 9th Edition, Elsevier, 2017.
2. CCPS (Center for Chemical Process Safety), *"Layer of Protection Analysis: Simplified Process Risk Assessment"*, AIChE, 2001.
3. Hans-Jürgen Schmidt, *"Functional Safety in Practice: System Design, Implementation, and Operation"*, Wiley, 2020.
4. Mohamed A. El-Reedy, *"Assessing and Managing Risk in Engineering, Work, and Life"*, CRC Press, 2021.
5. Trevor A. Kletz, *"Process Plants: A Handbook for Inherently Safer Design"*, CRC Press, 2009.


**Web References**

1. Instrumentation Tools - Safety Instrumented Systems
2. Safeopedia - Safety Instrumented Systems Definition
3. NPTEL - Industrial Safety Engineering
4. International Society of Automation (ISA) - Functional Safety
5. Exida - Safety and Reliability Resources

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | | Program Specific Outcomes(PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 1 | 1 | - | 1 | - | - | - | - | 3 | - | 2 | 1 | 1 | 2 |
| 2 | 3 | 2 | 1 | - | 1 | 2 | 2 | - | - | 3 | - | 2 | 2 | 2 | 2 |
| 3 | 3 | 2 | 2 | - | 2 | 2 | 1 | - | - | 3 | - | 2 | 2 | 2 | 2 |
| 4 | 2 | 2 | 2 | - | 2 | 2 | 1 | - | - | 3 | - | 2 | 2 | 2 | 2 |
| 5 | 3 | 2 | 3 | - | 2 | 2 | 2 | - | - | 3 | - | 2 | 2 | 3 | 2 |

**Correlation Level: 1 - Low, 2- Medium, 3 – High**

**Evaluation Method**

| Assessment | Continuous Assessment Marks (CAM) | | | | | End Semester Examination (ESE) Marks | Total Marks |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model Exam | Assignment* | Attendance | | |
| Marks | 5 | 5 | 5 | 5 | 5 | 75 | 100 |

***** Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Dr. L. M. Varalakshmi

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)

**DEPARTMENT OF**
**INSTRUMENTATION AND CONTROL ENGINEERING**

Curriculum and Syllabi for

# B.Tech (Honours / Minor): Sensors Technology

Regulations 2023
(R-2023)

# Curriculum

**HONOURS / MINOR PROGRAMME - SENSORS TECHNOLOGY**

| COURSE DETAILS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Semester** | **Course Code** | **Course Title** | **Category** | **Periods** | | | **Credits** | **Max. Marks** | | |
| | | | | | **L** | **T** | **P** | | **CAM** | **ESM** | **Total** |
| **Theory** | | | | | | | | | | | |
| 1 | IV | U23SXB401 | Smart Sensors | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 2 | V | U23SXT502 | Nano Biosensors* | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 3 | VI | U23SXB603 | Embedded Sensing Technologies | PC | 3 | 0 | 2 | 4 | 50 | 50 | 100 |
| 4 | VII | U23SXT704 | IoT and Sensor Networks* | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 5 | VIII | U23SXT805 | Wearable Devices and its Applications* | PC | 3 | 0 | 0 | 3 | 25 | 75 | 100 |
| 6 | VIII | U23SXW806 | Project / Model Making | PA | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| | **Total** | | | | | | | **19** | **225** | **375** | **600** |
| **Equivalent NPTEL courses[##]** | | | | | | | | | | | |
| 1 | IV to VII Semester | U23XXXN01 | Sensors Technology Equivalent NPTEL Courses | | | | | 3 | 12 Week Course | | |

[##] The student shall be given an option to earn 3 credits through one equivalent 12 week NPTEL course instead of any one course listed for honours / minor degree programme that should be completed before the commencement of eighth semester. The equivalent courses are subject to change based on its availability as per NPTEL course list.

## *List of NPTEL Courses

1. Sensors and Actuators
2. Biophotonics
3. Embedded Systems Design
4. Introduction to Industry 4.0 and Industrial Internet of Things
5. Microsensors, Implantable Devices and Rodent Surgeries for Biomedical Applications

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech. Honours /Minor: Sensors Technology** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **IV** | Course Category Code: PC | | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23SXB401** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Smart Sensors** | **3** | **0** | **2** | **4** | **50** | **50** | **100** |

**Common to All Branches**

| Prerequisite | Basic Electronics | |
|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
| | **CO1** Understand the fundamentals of smart sensors, their classification, and their differences from traditional sensors. | **K2** |
| | **CO2** Describe the sensor fusion techniques and energy management strategies used for optimizing sensor performance. | **K3** |
| | **CO3** Interpret real-world applications of smart sensors in industries, healthcare, smart cities, and smart homes. | **K2** |
| | **CO4** Design sensor-based systems for real-time monitoring and automation. | **K2** |
| | **CO5** Develop advanced sensor systems for environmental and health monitoring. | **K2** |

| **UNIT – I** | **Introduction to Smart Sensors** | **Periods:10** |
|---|---|---|
| Overview of smart sensors, Comparison with traditional sensors, Need for smart sensor and its challenges, Model of a smart sensor.<br>Classification of smart sensors: Temperature and Humidity Sensor (DHT11), pressure sensor (MS5611), Accelerometer sensor(MPU6050), Luminous Sensor(TSL2591), Gas sensor(MQ-135), Optical fingerprint sensor(GT511C3), Sound detection sensor (MAX9814), Digital Image sensor(CCD/CMOS), MEMS Sensor. | | **CO1** |
| **UNIT – II** | **Sensor Fusion and Energy management** | **Periods:10** |
| **Sensor fusion**: Introduction to Sensor Fusion, Advantage of sensor fusion, **Three Processing Architectures**: Data Level, Feature Level and Decision Level in sensor fusion. **Network topology**: centralized, decentralized and hierarchical (hybrid) fusion, **Sensor fusion algorithm**: Bayesian Filtering, Complementary Filter, Dempster-Shafer Theory, Weighted Average, Convolutional Neural Networks (CNNs). **Energy management:** Introduction, Thermoelectric Energy Harvesting, Vibration and Motion Energy Harvesting, RF energy harvesting. | | **CO2** |
| **UNIT – III** | **Applications of Smart Sensors** | **Periods:10** |
| Case Studies: **Industrial Automation** - Predictive Maintenance, Safety Monitoring.<br>**Healthcare**- Wearable Devices (smart watch, Smart clothing), Remote Patient Monitoring, Smart Prosthetics.<br>**Smart Cities** - Traffic Management, Air Quality Monitoring, Smart Lighting.<br>**Smart Homes** - Home Automation, Voice Assistants, Energy Management. | | **CO3** |
| **UNIT – IV** | **Sensor-Based Monitoring and Automation Systems** | **Periods:15** |
| **Hardware / Simulation**<br>1. Implementation of an RGB Color Detection System Using the TCS3200 Sensor and Arduino.<br>2. Design and Development of a Fire Detection System Using a Flame Sensor and Arduino.<br>3. Real-Time Temperature Monitoring for HVAC Systems.<br>4. Condition Monitoring of Rotating Equipment Using a Vibration Sensor.<br>5. Development of a Smart Waste Management System Using an Ultrasonic Sensor. | | **CO4** |
| **UNIT – V** | **Advanced Sensor-Based Systems for Environmental and Health Monitoring** | **Periods:15** |
| **Hardware / Simulation**<br>1. Analysis of Ambient Sound Levels Using a Sound Sensor for Event-Triggered Responses.<br>2. Smart Water Leak Detection and Alert System.<br>3. Automated Irrigation System for Precision Agriculture Using Arduino Uno.<br>4. Development of a Wearable Health Monitoring Device Using Accelerometer, Heart Rate (PPG), and $SpO_2$ Sensors.<br>5. Smart Flood Detection and Management System Using Water Level and Rainfall Sensors. | | **CO5** |

| **Lecture Periods:30** | **Tutorial Periods:-** | **Practical Periods:-30** | **Total Periods:60** |
|---|---|---|---|

**Text Books**


1. Randy Frank, “Understanding Smart Sensors”, Artech House, 2013.
2. Gerard Meijer, Kofi Makinwa, Michiel Pertijs, “Smart Sensor Systems Emerging Technologies and Applications”, Wiley, 2014.
3. H. Yamasaki, “Intelligent Sensors”, Elsevier Science, 1996.




Dr. L. M. Varalakshmi

**Reference Books**


1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 4th edition, Springer, New York, 2014.
2. Wilson Jon, “Sensor Technology Handbook”, Elsevier Inc, 2005.
3. Pavel Ripka, Alois Tipek, “Modern Sensors Handbook”, ISTE LTD, 2007.
4. D Patranabis, “Sensors and Transducers”, PHI 2nd Edition 2013.
5. Simon Monk, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", O'Reilly Media, 2019.


**Web References**

1. https://www.elprocus.com/smart-sensor/
2. https://www.fourfaith.com/industry-news/smart-sensor.html
3. https://www.bosch-sensortec.com/products/smart-sensor-systems/
4. https://www.fierceelectronics.com/electronics/what-are-smart-sensors
5. https://www.youtube.com/watch?v=oRydUfgMdgA

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 3 | 2 | 3 |
| 2 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 3 | 2 | 3 |
| 3 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 3 | 2 | 3 |
| 4 | 1 | 3 | 1 | 3 | 2 | - | - | - | - | - | 2 | 3 | 2 | 3 |
| 5 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 2 | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

<table>
<tr><td rowspan="2">Assessment</td><td colspan="10">Continuous Assessment Marks (CAM) – Maximum 50 Marks</td><td rowspan="2">##End Semester Examination (ESE) Marks (Theory)</td><td rowspan="2">Total Marks (CAM+ESE)</td></tr>
<tr><td colspan="5">Continuous Assessment (Theory)</td><td colspan="5">Continuous Assessment (Practical)</td></tr>
<tr><td></td><td>CAT 1</td><td>CAT 2</td><td>Model##</td><td>Attendance##</td><td>Total</td><td>Conduction of Practical</td><td>Report</td><td>Viva</td><td>Total</td><td>End Semester Examination ESE) Marks (Practical)</td><td></td><td></td></tr>
<tr><td>Portion for Test</td><td>1 ½ Units</td><td>1 ½ Units</td><td>All 3 Units</td><td rowspan="4"></td><td rowspan="4"></td><td colspan="4" rowspan="2"></td><td rowspan="2">Practical Exam</td><td>All 3 Units</td><td rowspan="6"></td></tr>
<tr><td rowspan="2">Assessment Methodology</td><td>MCQ Test</td><td>MCQ Test</td><td>Written Exam</td><td>Written Exam</td></tr>
<tr><td colspan="3">50 Questions for Analytical Course<br>75 Questions for Theory Course</td><td colspan="4"></td><td></td><td></td></tr>
<tr><td>Duration of the Test</td><td>1 hour 30 Minutes</td><td>1 hour 30 Minutes</td><td>3 hours</td><td colspan="4"></td><td>3 hours</td><td>3 hours</td></tr>
<tr><td>Marks</td><td>50</td><td>50</td><td>75</td><td>5</td><td>15</td><td>10</td><td>5</td><td>30*</td><td>30</td><td>75 (To be weighted for 50 Marks)</td></tr>
<tr><td>Weightage of CAM</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>10</td><td colspan="3">*To be weighted for 10 Marks</td><td>10</td><td>30</td><td></td></tr>
<tr><td>CAM / ESE Marks</td><td colspan="10">CAM Marks =10+10+30=50</td><td>ESE Marks = 50</td><td>100</td></tr>
</table>

## *Distribution* of Marks for Attendance, the Question Paper Pattern for Model and ESE are same as given in B. Tech. Regulations R2023 for Theory cum practical Courses



Dr. L. M. Varalakshmi

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Biomedical Engineering** | Programme: **B.Tech. Honours / Minor** | | | | | | |
| Semester | **V** | Course Category: PC | | | | End Semester Exam Type: **TE** | | |
| Course Code | **U23SXT502** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Nano Biosensors** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |
| Prerequisite | **-** | | | | | | | |
| | **Common to All Branches** | | | | | | | |

| | | | |
|---|---|---|---|
| **Course Outcomes** | **On completion of the course, the students will be able to** | | BT Mapping (Highest Level) |
| | **CO1** | Explain biosensor basics, components, and the role of nanotechnology in enhancing performance. | **K2** |
| | **CO2** | Classify nanomaterials and outline fabrication and surface functionalization methods. | **K2** |
| | **CO3** | Apply design principles, transduction methods, and signal amplification in nano biosensors. | **K3** |
| | **CO4** | Analyze nano biosensor applications in healthcare, environment, food, and drug discovery. | **K4** |
| | **CO5** | Evaluate emerging trends like wearable sensors, lab-on-chip, and IoT-based biosensing. | **K5** |

| | | |
|---|---|---|
| **UNIT-I** | **Introduction to Biosensors and Nanotechnology** | **Periods: 09** |
| Basics of Biosensors - - Definition and historical overview - Components of biosensors: Bioreceptor, transducer, and detector - Overview of biosensor applications. Introduction to nanomaterials and their unique properties - Role of nanotechnology in enhancing biosensor performance. | | **CO1** |
| **UNIT-II** | **Nanomaterials in Biosensors** | **Periods: 09** |
| Types of Nanomaterials - - Carbon-based nanomaterials (e.g., carbon nanotubes, graphene) - Metal nanoparticles (e.g., gold, silver) - Semiconductor nanoparticles (quantum dots) - Conducting polymers. Fabrication Techniques- Top-down and bottom-up approaches - Self-assembly and template synthesis - Surface functionalization strategies. | | **CO2** |
| **UNIT-III** | **Design of Nano Biosensors** | **Periods: 09** |
| Design Principles of Nano Biosensors - Transduction mechanisms (optical, electrochemical, mechanical) - Bioreceptor immobilization techniques - Signal amplification strategies. | | **CO3** |
| **UNIT-IV** | **Applications of Nano Biosensors** | **Periods: 09** |
| Clinical diagnostics and point-of-care testing - Environmental monitoring - Food safety and quality control - Drug discovery and pharmacokinetics. | | **CO4** |
| **UNIT-V** | **Current Trends and Future Directions** | **Periods: 09** |
| Innovations in Nano Biosensor Technology- Wearable biosensors - Lab-on-a-chip devices - Single-molecule detection - Internet of Things (IoT) integration. | | **CO5** |

**Lecture Periods: 45** **Tutorial Periods: -** **Practical Periods: -** **Total Periods: 45**

**Textbooks**


1. Aiguo Wu, "Nano Biosensors: From Design to Applications", Springer, 1st edition, 2016.
2. Sandro Carrara, "Nano biosensors and Nano bioanalyses", Elsevier, 1st edition, 2015.
3. Dmitry Zemlyanov,"Nano biosensors: Carbon Nanotubes and Graphene", CRC Press, 1st edition, 2013.


**Reference Books**


1. Alexandru Grumezescu, "Nano biosensors: Nanotechnology in the Agri-Food Industry", Academic Press, 1st edition, 2016.
2. Sandro Carrara,"Nano biosensors: Theory and Applications in Healthcare", Springer, 1st edition, 2016.
3. Abhijit Bandyopadhyay,"Nano biosensors: Carbon Nanotubes in Disease Diagnosis", CRC Press, 1st edition, 2012.
4. Bharath Bhushan, " Hand Book of Nano Technology",Springer-Verlag,3rd Edition, 2010.
5. H.S Nalwa , "Handbook of Thin Film Materials", American Scientific Publishers, Volume 5,2002.


**Web References**

1. https://wires.onlinelibrary.wiley.com/doi/abs/10.1002/wnan.136
2. https://www.ncbi.nlm.nih.gov/
3. https://www.nano.gov/
4. http://met.usc.edu/projects/nano.php
5. https://www.mdpi.com/2079-4991/14/21/1771

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* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| 1 | 3 | 2 | - | - | 2 | - | - | - | - | - | - | 3 | - | - |
| 2 | 3 | 3 | 2 | - | 3 | - | - | - | - | - | - | 3 | 2 | - |
| 3 | 3 | 3 | - | 2 | - | - | - | - | - | - | - | 3 | 2 | - |
| 4 | 3 | - | 3 | 2 | 3 | - | - | - | - | - | - | 3 | 2 | 2 |
| 5 | 3 | - | 3 | 2 | 3 | 2 | - | - | - | 2 | 3 | 3 | 2 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

| | Continuous Assessment Marks (CAM) | | | | | End Semester Examination## | Total Marks (CAM+ESE) |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model## | Assignment# | Attendance## | | |
| **Portion for Test** | 2 Units | 2 Units | All 5 Units | | | All 5 Units | |
| **Assessment Methodology** | MCQ Test | MCQ Test | Written Exam | Individual Task # | | Written Exam | |
| | 50 Questions for Analytical Course 75 Questions for Theory Course | | | | | | |
| **Duration of the Test** | 1 hour 30 Minutes | 1 hour 30 Minutes | 3 hours | | | 3 hours | |
| **Test Marks** | 50 | 50 | 75 | 20 | 5 | 75 | |
| **Weightage for CAM** | 5 | 5 | 5 | 5 | 5 | | |
| **CAM / ESE Marks** | **CAM Marks = 25** | | | | | **ESE Marks = 75** | **100** |

# Open Book Analytical Exam/Analyse Real world problems and propose solutions/ Tool or Subject Proficiency Analysis – Test the Students skill by giving individual task/ Paper Presentation/Micro Project Presentation/Idea Presentation for the Societal Problem;(Questions standard shall be of level 3 or more in Blooms Taxonomy)



Dr. A. Vijayalakshmi

| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech. Honours / Minor** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Semester | **VI** | Course Category Code: PC | | | *End Semester Exam Type:**TE** | | | |
| Course Code | **U23SXB603** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Embedded Sensing Technologies** | **3** | **1** | **0** | **4** | **50** | **50** | **100** |

**Common to All Branches**

Prerequisite

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| | **CO1** Understand embedded system fundamentals. | **K2** |
| | **CO2** Learn communication protocols and interfaces. | **K3** |
| | **CO3** Explore RTOS concepts and multitasking. | **K2** |
| | **CO4** Interface sensors and actuators in projects. | **K2** |
| | **CO5** Develop real-time embedded applications. | **K2** |

| **UNIT – I** | **Embedded System Fundamentals** | **Periods: 10** |
|---|---|---|
| System - Embedded System - Embedded Hardware Units and Devices in System-Embedded Software in a System - Embedded System-On-Chip (SoC) . ADC – DAC – Successive approximation – Timers and Counters – Watch dog Timer –Burn out Reset. Memory - Power Management. Hard and Soft Real-Time Embedded System. | | **CO1** |

| **UNIT – II** | **Peripherals and Interfaces** | **Periods: 10** |
|---|---|---|
| Embedded Communication Protocols - UART - SPI - I2C - CAN - Wireless Communication – Bluetooth - Zigbee - LoRa . Sensors: Accelerometer, Ultrasonic sensor, Flex sensor, Infrared sensor, PIR and Bio Sensors :(ECG, EEG,EMG,EOG ) – Actuators and motor Driver- H bridge. | | **CO2** |

| **UNIT – III** | **RTOS Based Embedded system design** | **Periods: 10** |
|---|---|---|
| Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Introduction to Raspberry pi and Applications | | **CO3** |

| **UNIT – IV** | **Sensor and Actuators interfacing** | **Periods: 15** |
|---|---|---|
| **Hardware / Simulation**<br>1. Gesture Control Vehicle using Accelerometer<br>2. Light Intensity Control using a Variable Resistor.<br>3. Automatic Door and Valve Control using Passive Infrared (PIR) Sensor<br>4. Collision Avoidance Vehicle using Infrared (IR) Sensor.<br>5. Motor Speed Control Using Pulse width modulation.<br>6. Patient Monitoring system | | **CO4** |

| **UNIT – V** | **Real time Applications** | **Periods: 15** |
|---|---|---|
| **Hardware / Simulation**<br>1. Embedded Weather Station for Real-Time Climate Data Collection<br>2. LDR-Based Automatic Street Light System<br>3. Ultrasonic-Based Distance Measurement<br>4. USV using Serial Communication<br>5. Embedded Home Automation System<br>6. Home Security Email Alert System Using Raspberry Pi | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-15** | **Total Periods:60** |
|---|---|---|---|

**Text Books**


1. Embedded System Design-Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things.4th edition .Springer 2021.
2. Hands-On RTOS with Microcontrollers, Brian Amos, 2020.
3. Rajkamal, 'Embedded system-Architecture, Programming, Design, McGraw-Hill Edu, 3rd edition 2017.


**Reference Books**


1. Shibu. K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2nd edition 2017.




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2. Lya B.Das," Embedded Systems" ,Pearson Education, 1st edition 2012.
3. Parag H.Dave,Himanshu B.Dave," Embedded Systems-Concepts ,Design and Programming, Pearson Education,2015, 1st edition.
4. Elicia White, "Making Embedded systems", O'Reilly Series ,SPD,2011, 1st edition.


**Web References**


1. https://nptel.ac.in/courses/108102045
2. https://www.circuitbasics.com/basics-of-the-i2c-communication-protocol/
3. https://www.tutorialspoint.com/embedded_systems/es_interrupts.htm
4. https://link.springer.com/book/10.1007/978-3-030-60910-8


TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 2 | 1 | 2 |
| 2 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 2 | 1 | 2 |
| 3 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 2 | 1 | 2 |
| 4 | 1 | 3 | 1 | 3 | 2 | - | - | - | - | - | 1 | 2 | 1 | 2 |
| 5 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | 1 | 2 | 1 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

| Assessment | Continuous Assessment Marks (CAM) – Maximum 50 Marks | | | | | | | | | ##End Semester Examination (ESE) Marks (Theory) | Total Marks (CAM+ESE) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Continuous Assessment (Theory) | | | | | Continuous Assessment (Practical) | | | | | |
| | CAT 1 | CAT 2 | Model## | Attendance## | Total | Conduction of Practical | Report | Viva | Total | End Semester Examination ESE) Marks (Practical) | |
| Portion for Test | 1 ½ Units | 1 ½ Units | All 3 Units | | | | | | | | All 3 Units |
| Assessment Methodology | MCQ Test | MCQ Test | Written Exam | | | | | | | Practical Exam | Written Exam |
| | 50 Questions for Analytical Course 75 Questions for Theory Course | | | | | | | | | | |
| Duration of the Test | 1 hour 30 Minutes | 1 hour 30 Minutes | 3 hours | | | | | | | 3 hours | 3 hours |
| Marks | 50 | 50 | 75 | 5 | | 15 | 10 | 5 | 30* | 30 | 75 *(To be weighted for* 50 Marks) |
| Weightage of CAM | 2.5 | 2.5 | 2.5 | 2.5 | **10** | **To be weighted for 10 Marks* | | | **10** | **30** | |
| **CAM / ESE Marks** | ***CAM Marks =10+10+30=50*** | | | | | | | | | ***ESE Marks = 50*** | **100** |

## *Distribution* of Marks for Attendance, the Question Paper Pattern for Model and ESE are same as given in B.Tech. Regulations R2023 for Theory cum practical Courses



Dr. L. M. Varalakshmi

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech. Honours / Minor** | | | | | | |
| Semester | **VII** | Course Category Code: PC | | | | *End Semester Exam Type:**TE** | | |
| Course Code | **U23SXT704** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **IoT and Sensor Networks** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

**Common to All Branches**

Prerequisite

| **Course Outcomes** | **On completion of the course, the students will be able to** | BT Mapping (Highest Level) |
|---|---|---|
| **CO1** | Understand the architecture of IoT | **K2** |
| **CO2** | Acquaint on fundamentals of wireless sensor networks | **K2** |
| **CO3** | Interpret the protocols of WSNs | **K2** |
| **CO4** | Gain knowledge on middleware and operating systems for WSNs | **K2** |
| **CO5** | Impart knowledge on case studies on IoT implementations. | **K3** |

| **UNIT – I** | **Architecture of IoT** | **Periods:09** | |
|---|---|---|---|
| The History and Reasoning Behind the IoT - The IoT Architectural Reference Model as Enabler - IoT in Practice: Examples: IoT in Logistics and Health – Elements to protect in IoT- Risk sources –Addressing performance and scalability – Addressing – Addressing Security – Addressing Privacy- Addressing Availability and Resilience | | | **CO1** |
| **UNIT – II** | **Introduction to Wireless Sensor Networks(WSN)** | **Periods:09** | |
| IoT Reference Architecture - Interaction of all sub models – Domain Model – Information Model - Functional Model – Communication Model – Trust, Security and Privacy Background of Sensor Network Technology - Basic Sensor Network Architectural Elements- Brief Historical Survey of Sensor Networks - Challenges and Hurdle - Applications of Wireless Sensor Networks. | | | **CO2** |
| **UNIT – III** | **Protocols for WSNs** | **Periods:09** | |
| Fundamentals of MAC Protocols - MAC Protocols for WSNs - Sensor-MAC Case Study – Routing Challenges in WSNs - Routing Strategies in WSNs - Transport Protocol Design Issues- Examples of Existing Transport Control Protocols - Performance of Transport Control Protocols | | | **CO3** |
| **UNIT – IV** | **Middleware and Operating systems for WSNs** | **Periods:09** | |
| WSN Middleware Principles- Middleware Architecture - Existing Middleware : MiLAN - IrisNet - AMF - DSWare - CLMF - MSM – Em –Impala – Dfuse -DDS – Sensor Ware.<br>Operating System- Examples of Operating Systems – TinyOS - Mate – MagnetOS – MANTIS – OSPM - EYES OS – SenOS – EMERALDS – PICOS | | | **CO4** |
| **UNIT – V** | **CASE STUDY – IoT Implementations** | **Periods:09** | |
| Case study: Smart Grid &IoT, Commercial building automation using IoT, Recent trends in sensor network and Automation in Industrial aspect of IOT. | | | **CO5** |

| **Lecture Periods:45** | **Tutorial Periods:-** | **Practical Periods:-** | **Total Periods:45** |
|---|---|---|---|

**Text Books**


1. Raj Kamal, "Internet of Things-Architecture and design principles", McGraw Hill Education.
2. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
3. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.


**Reference Books**


1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, “Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model”, Springer Open, 2016.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine to Machine to Internet of Things”, Elsevier Publications, 2014.
3. Vijay Madisetti, Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally “Internet of Things A Hands-on-Approach” Arshdeep Bahga & Vijay Madisetti, 2014.
4. Barrie Sosinsky, “Cloud Computing Bible”, Wiley-India, 2010.


**Web References**

1. https://www.geeksforgeeks.org/wireless-sensor-network-wsn/
2. https://mrcet.com/downloads/digital_notes/EEE/IoT%20&%20Applications%20Digital%20Notes.pdf
3. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
4. https://www.iotforall.com/wireless-sensors-for-iot



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5. https://www.tutorialspoint.com/difference-between-wireless-sensor-networks-and-iot

* TE – Theory Exam, LE – Lab Exam

**COs/POs/PSOs Mapping**

| COs | Program Outcomes (POs) | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | - | 1 | 3 | 2 | 3 |
| 2 | 2 | 2 | 2 | 1 | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 3 |
| 3 | 2 | 2 | 2 | 1 | 1 | 1 | - | - | - | - | 1 | 3 | 2 | 3 |
| 4 | 3 | 2 | 3 | 1 | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 3 |
| 5 | 2 | 2 | 3 | 1 | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 3 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

| | Continuous Assessment Marks (CAM) | | | | | End Semester Examination## | Total Marks (CAM+ESE) |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model## | Assignment# | Attendance## | | |
| **Portion for Test** | 2 Units | 2 Units | All 5 Units | | | All 5 Units | |
| **Assessment Methodology** | MCQ Test | MCQ Test | Written Exam | Individual Task # | | Written Exam | |
| | 50 Questions for Analytical Course 75 Questions for Theory Course | | | | | | |
| **Duration of the Test** | 1 hour 30 Minutes | 1 hour 30 Minutes | 3 hours | | | 3 hours | |
| **Test Marks** | 50 | 50 | 75 | 20 | 5 | 75 | |
| **Weightage for CAM** | 5 | 5 | 5 | 5 | 5 | | |
| **CAM / ESE Marks** | **CAM Marks = 25** | | | | | **ESE Marks = 75** | **100** |

# Open Book Analytical Exam/Analyse Real world problems and propose solutions/ Tool or Subject Proficiency Analysis – Test the Students skill by giving individual task/ Paper Presentation/Micro Project Presentation/Idea Presentation for the Societal Problem;(Questions standard shall be of level 3 or more in Blooms Taxonomy)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Biomedical Engineering** | Programme: **B.Tech. Honours / Minor** | | | | | | |
| Semester | **VIII** | Course Category: **PC** | | | | 'End Semester Exam Type: **TE** | | |
| Course Code | **U23SXT805** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Wearable Devices and its Applications** | **3** | **0** | **0** | **3** | **25** | **75** | **100** |

**Common to All Branches**

Prerequisite: **-**

| Course Outcomes | | On completion of the course, the students will be able to | BT Mapping (Highest Level) |
|---|---|---|---|
| | **CO1** | Understand design, functionality, applications, and challenges of wearable devices in healthcare and technology. | **K2** |
| | **CO2** | Familiarize the smart textiles, signal processing, and energy harvesting for innovative, efficient, and sustainable wearable devices. | **K3** |
| | **CO3** | Comprehend the principles, design, and applications of wearable biochemical and gas sensors for healthcare monitoring. | **K2** |
| | **CO4** | Comprehend the design and development of various wearable bio-electrode and physiological activity monitoring devices for use in healthcare applications. | **K3** |
| | **CO5** | Impart knowledge on IoT integration in wearables, analyze applications, and evaluate real-world case studies effectively. | **K3** |

| | | | |
|---|---|---|---|
| **UNIT-I** | **Introduction to Wearable Devices** | **Periods: 09** | |
| Wearable Systems- Introduction, Need for Wearable Systems, Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems- Inertia movement sensors, Respiration activity sensor, Wearable ground reaction force sensor. | | | **CO1** |
| **UNIT-II** | **Smart Textile, Signal Processing and Energy Harvesting for Wearable Devices.** | **Periods: 09** | |
| Introduction to smart textile- Passive smart textile, active smart textile- Fabrication Techniques. Wearability issues - physical shape and placement of sensor, sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests. | | | **CO2** |
| **UNIT-III** | **Wearable Biochemical and Gas Sensors** | **Periods: 09** | |
| Wearable Biochemical Sensors: Parameters of interest –Textile based, Microneedle based; Types: Noninvasive Glucose Monitoring Devices, GlucoWatch G2 Biographer, GlucoTrackTM; Pulse oximeter, Portable & wearable; Wearable capnometer for monitoring of expired carbon dioxide. Wearable gas sensors: Metal Oxide (MOS) type, electrochemical type, new materials-CNTs, graphene, Zeolites; Detection of atmospheric pollutants. | | | **CO3** |
| **UNIT-IV** | **Wearable Devices for Healthcare** | **Periods: 09** | |
| Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles – thermistor, infrared radiation, thermopile, Modality of measurement wearable, adhesive/tattoo type. Conductive textile electrodes, Knitted Piezoresistive Fabric (KPF) sensors. | | | **CO4** |
| **UNIT-V** | **Role of IoT in Wearable Devices and Case Study** | **Periods: 09** | |
| Evolution of wearable technology, Smart connectivity and big picture of IoT-smart devices, networks, Wireless technologies and need for data analysis, Wearable IoT use cases- Smart watches, Android wear, Smart glasses, fitness trackers, health care devices, cameras, smart clothing. Case studies – Health care, fitness and sports, defense and security, fashion and apparel. | | | **CO5** |

**Lecture Periods: 45** | **Tutorial Periods:-** | **Practical Periods: -** | **Total Periods: 45**

**Text Books**


1. Gilmore, Bringers of Order: Wearable Technologies and the Manufacturing of Everyday Life, University of California Press, 2023
2. Charlton, P.H., Signal Processing and Learning for Wearables, 2023
3. Tamura, T., & Chen, W., Seamless Healthcare Monitoring, Springer, 2018.


**Reference Books**


1. Sazonov, E., & Neuman, M.R., Wearable Sensors: Fundamentals, Implementation and Applications, Academic Press, 2020.
2. Bello, Y., & Figetakis, E., IoT-based Wearables: A Comprehensive Survey, 2023.
3. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
4. N. Luo, W. Dai, C. Li, Z. Zhou, L. Lu, C. C. Y. Poon, et al., "Flexible Piezoresistive Sensor Patch Enabling Ultralow Power Cuffless Blood Pressure Measurement," Advanced Functional Materials, vol. 26, pp. 1178-1187, 2016.




A.

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**Web References**

1. https://onlinecourses.nptel.ac.in/noc23_ee95/preview?utm_source
2. https://www.youtube.com/watch?reload=9&v=Sj5yz9hNvoM
3. https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206 Diagnostic and Therapeutic EquipmentTraining.pdf

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| COs | Program Outcomes (POs) | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
| 1 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 1 | 2 |
| 2 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 1 | 2 |
| 3 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 1 | 2 |
| 4 | 1 | 3 | 1 | 3 | 2 | - | - | - | - | - | - | 2 | 1 | 2 |
| 5 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 1 | 2 |

**Correlation Level: 1 - Low, 2 - Medium, 3 – High**

| | Continuous Assessment Marks (CAM) | | | | | End Semester Examination## | Total Marks (CAM+ESE) |
|---|---|---|---|---|---|---|---|
| | CAT 1 | CAT 2 | Model## | Assignment# | Attendance## | | |
| **Portion for Test** | 2 Units | 2 Units | All 5 Units | | | All 5 Units | |
| **Assessment Methodology** | MCQ Test | MCQ Test | Written Exam | Individual Task # | | Written Exam | |
| | 50 Questions for Analytical Course 75 Questions for Theory Course | | | | | | |
| **Duration of the Test** | 1 hour 30 Minutes | 1 hour 30 Minutes | 3 hours | | | 3 hours | |
| **Test Marks** | 50 | 50 | 75 | 20 | 5 | 75 | |
| **Weightage for CAM** | 5 | 5 | 5 | 5 | 5 | | |
| **CAM / ESE Marks** | **CAM Marks = 25** | | | | | **ESE Marks = 75** | **100** |

# Open Book Analytical Exam/Analyse Real world problems and propose solutions/ Tool or Subject Proficiency Analysis – Test the Students skill by giving individual task/ Paper Presentation/Micro Project Presentation/Idea Presentation for the Societal Problem;(Questions standard shall be of level 3 or more in Blooms Taxonomy)



Dr. A. Vijayalakshmi

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Department | **Instrumentation and Control Engineering** | Programme: **B.Tech. Honours / Minor** | | | | | | |
| Semester | **VIII** | Course Category: **PA** | | | | End Semester Exam: **PA** | | |
| Course Code | **U23SXW806** | Periods/Week | | | Credit | Maximum Marks | | |
| | | L | T | P | C | CAM | ESE | TM |
| Course Name | **Project / Model Making** | **0** | **0** | **4** | **2** | **50** | **50** | **100** |

Each student is required to undertake a project or develop a model within the domain of Sensors Technology. The student must identify a specific area of specialization within this field, and the project will be carried out under the guidance of a faculty member assigned by the Head of the Department.

Students are expected to address real-world or relevant challenges by applying engineering principles to develop solutions through prototype development, simulations, coding, process establishment, synthesis, or correlation analysis.

The progress of the project will be systematically monitored and evaluated in accordance with established guidelines. Upon completion, students must submit a comprehensive report of at least 20 pages by the end of the eighth semester.

***Assessment Guidelines***

Student will be evaluated based on the below criteria.

| Criteria | Internal | External |
|---|---|---|
| Identification of Problem Domain | 5 | 5 |
| Study of Existing Systems and establishing clear objectives | 10 | 10 |
| Planning of project | 10 | 10 |
| Documentation and Technical Writing | 10 | 10 |
| Demonstration | 15 | 15 |
| **Total Marks** | **50** | **50** |



Dr. L. M. Varalakshmi