# AISSMS
# INSTITUTE OF INFORMATION TECHNOLOGY
# (IOIT)

ADDING VALUE TO ENGINEERING

An Autonomous Institute Affiliated to Savitribai Phule Pune University
Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra
Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

# ACADEMIC COURSE STRUCTURE

## Third Year B. Tech Instrumentation Engineering

## PROGRAM IN INSTRUMENTATION ENGINEERING

## B. Tech 4 Year UG Curriculum

## (2025 Pattern)

**AISSMS INSTITUTE OF INFORMATION TECHNOLOGY**
**Kennedy Road, Near RTO,**
**Pune – 411 001, Maharashtra State, India**
**Email: principal@aissmsioit.org,**
**Website: https://www.aissmsioit.org**

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# Institute Vision & Mission

**Vision:**

To be recognized amongst top 10 private engineering colleges in Maharashtra by the year 2026 by rendering value added education through academic excellence, research, entrepreneurial attitude, and global exposure.

**Mission :**

- To enable placement of 150 plus students in the 7 lacs plus category & ensure 100% placement of all final year students.
- To connect with 10 plus international universities, professional bodies, and organizations to provide global exposure students
- To create conducive environment for career growth, prosperity, and happiness of 100% staff.
- To be amongst top 5 private colleges in Pune in terms of admission cut off

# Quality Policy

We commit ourselves to provide quality education & enhance our students quality through continuous improvement in our teaching and learning processes.

# Department Vision & Mission

**Vision:**

To be recognized as one of the best instrumentation engineering programs by developing globally competent engineers, researchers and entrepreneurs to solve real life problems through skill-based education.

**Mission:**

M1:To promote learning for skill-based education and emerging technologies to make students globally competent.

M2:To create conducive environment for research, innovations and entrepreneurship.

# Program Educational Objectives:

Graduates will

1. solve real life problems by applying the knowledge of instrumentation technology.
2. pursue higher education or be researcher or be entrepreneur.
3. contribute as a socially responsible citizen for the development of nation.
4. for the development of nation.

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## Program Outcomes (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. [Engineering knowledge]
2. Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. [Problem analysis]
3. 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. [Design/development of solutions]
4. 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. [Conduct investigations of complex problems]
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. [Modern tool usage]
6. 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. [The engineer and society]
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. [Environment and sustainability]
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. [Ethics]
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. [Individual and team work]
10. 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. [Communication]
11. 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. [Project management and finance]
12. 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. [Life-long learning]

## Program Specific Outcomes(PSOs)

1. Graduates will be able to apply their knowledge of measurement and control to solve the problems related to environment, safety, health and agriculture sectors.

2. Graduates will be able to demonstrate their skills on Programmable logic controller, LabView, Distributed control system and Internet of thing.

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# Instrumentation Engineering– Third Year B. Tech (Semester–V)

| Sr. No. | Code | Course Title | Hours per week | | | Credits | Examination scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | ISE | ESE | TW | PR | OR | Total |
| 1 | IOHSM501 | Intellectual Property Rights @@ | 02 | --- | --- | 02 | --- | --- | 25 | --- | 25 | 50 |
| 2 | INPCC502 | Industrial Automation | 03 | 01 | --- | 04 | 40# | 60* | --- | --- | --- | 100 |
| 3 | INPCC503 | Modern Control Theory | 03 | --- | --- | 03 | 40# | 60** | --- | --- | --- | 100 |
| 4 | INPCC504 | Digital Signal Processing | 03 | 01 | --- | 04 | 40# | 60* | --- | --- | -- | 100 |
| 5 | INPEC505 | Professional Elective-I | 03 | --- | -- | 03 | 40# | 60* | --- | --- | --- | 100 |
| 6 | INOEC506 | MOOC (Automation In Production Systems and Management) | 03 | --- | -- | 03 | 40$ | 60$$ | --- | --- | --- | 100 |
| 7 | INPCC507 | Industrial Automation Lab | --- | --- | 02 | 01 | --- | --- | --- | 50 | -- | 50 |
| 8 | INPCC508 | Modern Control Theory Lab | -- | --- | 02 | 01 | --- | --- | 50 | -- | --- | 50 |
| 9 | INPEC509 | Professional Elective–I Lab | --- | --- | 02 | 01 | --- | --- | -- | --- | 50 | 50 |
| 10 | IOHSM5ACA | Audit Course Foreign Language Level-I(German) | 01 | -- | -- | 01 | --- | -- | 25 | -- | -- | 25 |
| | IOHSM5ACB | Audit Course Foreign Language Level-I(Japanese) | | | | | | | | | | |
| | | **Total** | **18** | **02** | **06** | **23** | **200** | **300** | **100** | **50** | **75** | **725** |
| **Instrumentation Engineering- Minor in Sensor and Control Technology** | | | | | | | | | | | | |
| 1 | INMNR501 | Industrial Automation | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | INMNR502 | Industrial Automation Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| | | **Grand Total** | **21** | **02** | **08** | **27** | **200** | **375** | **125** | **50** | **75** | **825** |
| **Computer Engineering -Minor in Software Development** | | | | | | | | | | | | |
| 1 | COMNR501 | Database Management System | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | COMNR502 | Database Management System Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| **Information Technology -Minor in Software Development Technologies** | | | | | | | | | | | | |
| 1 | ITMNR501 | Software Engineering & Project Management | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | ITMNR502 | Software Engineering & Project Management Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| **Artificial Intelligence and Data Science- Minor in Foundation of Artificial Intelligence** | | | | | | | | | | | | |
| 1 | ADMNR501 | Machine Learning | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | ADMNR502 | Machine Learning Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| **Institute Level- Minor in Innovation, Entrepreneurial and Venture Development** | | | | | | | | | | | | |
| 1 | IOMNR503 | UDYAM (Sales and Marketing) | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | IOMNR504 | UDYAM (Sales and Marketing lab) | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |

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(Once minor course is selected from Program, not allowed to change minor course of other Programs)

| **Professional Elective-I INPEC505** | | **Professional Elective-I INPEC509** | |
|---|---|---|---|
| INPEC505A | Web Technology | INPEC509A | Web Technology Lab |
| INPEC505B | Programming Practices JAVA | INPEC509B | Programming Practices JAVA Lab |
| INPEC505C | Biomedical Instrumentation | INPEC509C | Biomedical Instrumentation Lab |

| | |
|---|---|
| * | **End Semester Examination (ESE)** based on subjective questions. |
| ** | **Practical or Activity based Evaluation.** |
| # | **In Semester Evaluation 1** based on Subjective Examination. |
| | **In Semester Evaluation 2** based on Presentation / Group Discussion / Laboratory Work / Course Project / Home Assignment / Comprehensive Viva Voce/ Blog Writing / Case Study / Survey / GATE based MCQ examination/ Numerical based Subjective Examination. |
| ## | **End Semester Examination (ESE) based on objective questions.** |
| $ | **For MOOCs:** Assignments marks will be converted on the scale of 40 marks. |
| $$ | **For MOOCs:** Score of examination conducted by the respective authority of MOOC or Score of ESE Conducted by Institute will be converted on the scale of 60 marks. |
| @@ | To earn the credits, passing is mandatory in both the examination heads. |

**MOOC:** Automation In Production Systems and Management https://onlinecourses.nptel.ac.in/noc24_mg117/preview

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## Instrumentation Engineering– Third Year B. Tech (Semester–VI)

| Sr. No. | Code | Course Title | Hours per week | | | Credits | Examination scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | ISE | ESE | TW | PR | OR | Total |
| 1 | IOHSM601 | Seminar and Technical Paper Writing | 01 | --- | 02 | 02 | --- | --- | 50 | --- | --- | 50 |
| 2 | INPCC602 | Industrial Data Exchange | 03 | 01 | --- | 04 | 40# | 60* | --- | --- | --- | 100 |
| 3 | INPCC603 | Industrial Internet of Things | 03 | --- | --- | 03 | 40# | 60* | --- | --- | --- | 100 |
| 4 | INPCC604 | Project Engineering And Management | 03 | -- | --- | 03 | 40# | 60* | --- | --- | --- | 100 |
| 5 | INPEC605 | Professional Elective-II | 03 | --- | --- | 03 | 40# | 60** | --- | --- | --- | 100 |
| 6 | INVSE606 | Process Instrumentation@@ | 01 | --- | 04 | 03 | -- | -- | 50 | 50 | --- | 100 |
| 7 | INPCC607 | Project Engineering and Management Lab | --- | --- | 02 | 01 | --- | --- | --- | -- | 25 | 25 |
| 8 | INPCC608 | Industrial Internet of Things Lab | --- | --- | 02 | 01 | --- | --- | --- | 50 | --- | 50 |
| 9 | INPEC609 | Professional Elective-II Lab | --- | --- | 02 | 01 | --- | --- | 50 | -- | -- | 50 |
| 10 | INELC610 | Mini Project | -- | -- | 02 | 01 | -- | -- | 25 | -- | -- | 25 |
| 11 | IOHSM6ACA | Audit course Foreign Language Level-II (German) | 01 | -- | -- | 01 | -- | -- | 25 | -- | -- | 25 |
| | IOHSM6ACB | Audit course Foreign Language Level-II(Japanese) | | | | | | | | | | |
| 12 | IOLLC6L3 | Lifelong Learning Skills-III | -- | -- | -- | 01 | -- | -- | 25 | -- | -- | 25 |
| 13 | IOLLC6L4 | Lifelong Learning Skills-IV | -- | -- | -- | 01 | -- | -- | 25 | -- | -- | 25 |
| **Total** | | | **15** | **01** | **14** | **25** | **160** | **240** | **250** | **100** | **25** | **775** |
| **Instrumentation Engineering-Minor in Sensor and Control Technology** | | | | | | | | | | | | |
| 14 | INMNR601 | Project Engineering And Management | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 15 | INMNR602 | Project Engineering And Management Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| | | | **18** | **01** | **16** | **29** | **160** | **315** | **275** | **100** | **25** | **875** |
| **Computer Engineering -Minor in Software Development** | | | | | | | | | | | | |
| 1 | COMNR601 | Web Technology | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | COMNR602 | Web Technology Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| **Information Technology -Minor in Software Development Technologies** | | | | | | | | | | | | |
| 1 | ITMNR601 | | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | ITMNR602 | | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| **Artificial Intelligence and Data Science- Minor in Foundation of Artificial Intelligence** | | | | | | | | | | | | |

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ADMNR601 | Deep Learning | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | ADMNR602 | Deep Learning Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |
| **Institute Level- Minor in Innovation, Entrepreneurial and Venture Development** | | | | | | | | | | | | |
| 1 | IOMNR603 | UDYAM (Financial Management) | 03 | -- | -- | 03 | --- | 75## | --- | -- | -- | 75 |
| 2 | IOMNR604 | UDYAM (Financial Management) Lab | -- | -- | 02 | 01 | -- | -- | 25 | --- | --- | 25 |

(Once minor course is selected from Program, not allowed to change minor course of other Programs)

| | |
|---|---|
| * | **End Semester Examination (ESE)** based on subjective questions. |
| ** | **Practical or Activity based Evaluation.** |
| # | **In Semester Evaluation 1** based on Subjective Examination. |
| | **In Semester Evaluation 2** based on Presentation / Group Discussion / Laboratory Work / Course Project / Home Assignment / Comprehensive Viva Voce/ Blog Writing / Case Study / Survey / GATE based MCQ examination/ Numerical based Subjective Examination. |
| ## | **End Semester Examination (ESE) based on objective questions.** |
| @@ | To earn the credits, passing is mandatory in both the examination heads. |

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| Third Year B. Tech Instrumentation Engineering<br>Intellectual Property Rights | | | |
|---|---|---|---|
| **Course Code:** | IOHSM501 | **Credit** | 2 |
| **Contact Hours:** | 2 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | Term-work<br>25 marks | Oral<br>25 marks | |

**Pre-requisites:**
Nil

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Term Work | Internal | 25 |
| 2. | Oral | External | 25 |

| Course Objectives | |
|---|---|
| 1 | To explain the significance of Intellectual Property |
| 2 | To study various aspects of Patents |
| 3 | To understand the significance of patent information in Business development |
| 4 | To study patents documents and process for examination |

| Course Outcomes: Students will be able to | |
|---|---|
| 501.1 | Describe the significance of intellectual property |
| 502.2 | Discuss various aspects of patents |
| 503.3 | Search patent information in database |
| 504.4 | Explain patents documents and process for examination |
| 505.5 | Describe concepts related to trademarks |
| 506.6 | Differentiate copyright from patent |

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| Topics covered: |
|---|
| **UNIT I: INTRODUCTION (4 Hours)**<br>Meaning, Relevance, Business Impact, Types of Intellectual Property, Protection of Intellectual Property, Competing Rationales for Protection of Intellectual Property Rights, The World Intellectual Property Organization (WIPO) and the UNESCO. |
| **UNIT II : PATENT (4 Hours)**<br>Concept of Patent, Types of Product / Process Patents & Terminology, Duration of Patents-Law and Policy Consideration Elements of Patentability,- Novelty and Non Obviousness (Inventive Steps and Industrial Application, Non- Patentable Subject Matter, Procedure for Filing of Patent Application and types of Applications. |
| **UNIT III:PATENT DATABASES & PATENT INFORMATION SYSTEM (4 Hours)**<br>Patent Offices in India, Importance of Patent Information in Business Development, Patent search through Internet, Patent Databases. |
| **UNIT IV: PATENT DOCUMENTS & PROCESS FOR EXAMINATION (4 Hours)**<br>Lab Notebooks/Logbooks/Record Books, Methods of Invention Disclosures, Patent Application and its Contents, Writing of the Patent Document. Publication of Patent Applications, Request for Examination, Process for Examination & Prosecution, Reissue & Re-examination. |
| **UNIT V: TRADEMARKS (4 Hours)**<br>The rationale of protection of trademark as (a) an aspect of commercial and (b) of consumer rights, Definition and concept of Trademarks, Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) . |
| **UNIT VI COPYRIGHTS (4 Hours)**<br>Nature of Copyright, Works in which Copyrights subsist, Author & Ownership of Copyright , Rights Conferred by Copyright , Registration of Copyrights & Appeals. |

**Text Books:**

1. Intellectual Property Rights-Law And Practice By Laser Typesetting

**Reference Books**

1. Aswani Kumar Bansal ,"Law of Trademarks in India" ,Commercial Law Publishers, 2001
2. B L Wadehra," Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications" Universal Law Publishing Co Ltd.
3. G.V.G Krishnamurthy ," The Law of Trademarks, Copyright, Patents and Design"
4. Satyawrat Ponkse," The Management of Intellectual Property" Bhate & Ponkshe, 1991
5. S K Roy Chaudhary & H K Saharay ,"The Law of Trademarks, Copyright, Patents and Design.Legal Aspects of Technology Transfer: A Conspectus"

**E-Resources:**

1. Patent act:
https://ipindia.gov.in/writereaddata/Portal/IPOAct/1_31_1_patent-act-1970-11march2015.pdf

2. Practice and procedures:
https://ipindia.gov.in/writereaddata/Portal/Images/pdf/Manual_for_Patent_Office_Practice_and_Procedure_.pdf

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| Third Year B. Tech Instrumentation Engineering Industrial Automation | | | |
|---|---|---|---|
| **Course Code:** | **INPCC502** | **Credit** | **04** |
| **Contact Hours:** | 3 Hrs/week (L)<br>1 Hr/Weel(T) | **Type of Course:** | Lecture &<br>Tutorial |
| **Examinatio nScheme** | In-sem.<br>Evaluation<br>40 Marks | End-sem.<br>Examination<br>60 Marks | |

- **Pre-requisites:** Sensors and Transducers, Process Control Loop Components, Digital Techniques.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To introduce the basics of PLC, HMI,SCADA and DCS |
| 2 | To explain advanced PLC instructions and interfacing of analog and digital devices with PLC. |
| 3 | To explain the configuration, operation and programming of DCS. |
| 4 | To introduce advanced techniques like MES, ERP of industrial automation . |

| Course Outcomes: Students will be able to | |
|---|---|
| 502.1 | Understand the fundamentals of PLC, PLC interfacing and HMI. |
| 502.2 | Develop HMI/SCADA system for given applications. |
| 502.3 | Describe the software and hardware DCS configuration. |
| 502.4 | Explain DCS operation and integration. |
| 502.5 | Develop FBD program for automation and explain advanced techniques in DCS. |
| 502.6 | Explain various DCS applications. |

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| Topics covered: |
|---|
| **Unit I: Introduction to Industrial Automation**(08 hrs)<br>PLC: Architecture, programming, Applications<br>HMI: Need of HMI, Advantages of HMI<br>Interfacing: PLC interfacing to HMI, Drives, Actuators, Scanners, Printers, Robots |
| **Unit II: Supervisory Control & Data Acquisition (SCADA) (06 hrs)**<br>SCADA components, Applications and benefits, PLC vs RTU, Types of SCADA: Client server based, Stand alone, web based. Trending, Historical data storage & Reporting, Alarm management, Development of application using SCADA System. |
| **Unit III:. Introduction to Distributed Control System and its configuration (07 hrs)**<br>Distributed Control System (DCS): Introduction, Functions, Architecture, system interfacing, Features, DCS Specification, Advantages, limitations<br>DCS Configuration: Structure and Configuration, redundancy concepts, Process variables, software variables, tags, Alarms, Trends, Databases. Basic DCS Controller Configuration, Function Blocks.<br>Comparison of DCS, PLC, and SCADA |
| **Unit IV: DCS Operation (07 hrs)**<br>DCS Operator Stations, Recorders, Loggers, Trend Displays, and Data Archiving,<br>HMI in the Control Room and in the Field: Mobile and remote devices. Alarms philosophy, Control & Management. Development and Applications, Logs, trends, and reports.<br>DCS Operation, Operational view of DCS, Role of operators, Integration and Optimization of DCS. |
| **Unit V: DCS Programming and advanced techniques (08 hrs)**<br>DCS Programming Languages (IEC 61131-3): Function block diagram (FBD), Sequential Function Chart (SFC), Advanced functions like ANN and MPC for process control.<br>Advanced techniques: Manufacturing Execution System (MES), Manufacturing Operations Management (MOM), Asset Performance Management (APM), Enterprise Resource Planning (ERP) |
| **Unit VI: DCS Applications (06 hrs)**<br>Applications: Use of DCS in pulp and paper environment, petroleum-refining environment, oil and gas processing environment, Cloud based application, Food and Beverage Industry, Water and Wastewater Treatment, HVAC and Building Automation, Automotive Industry |

**Text Books:**

1. Programmable Logic Controllers: Principles & Applications by John W. Webb, Ronald A. Reis, Prentice Hall of India, 5th ed.
2. Introduction to Programmable Logic Controllers by Gary Dunning, Delmar Thomson Learning, 3rd ed.
3. Krishna Kant, Computer-based Industrial Control, Prentice Hall, New Delhi, 1997.
4. Computer aided process control, S. K. Singh, PHI.

**References Books:**

1. Programmable Logic Controller by Frank D Petruzella, McGraw-Hill Education, 5th ed.
2. Programmable Logic Controllers by W. Bolton, Elsevier Newness publication, 4th ed.
3. Programmable Controller by T. A. Huges, ISA publication, 2nd ed.
4. SCADA by Stuart A. Boyer, ISA 1999.
5. Distributed computer control for industrial automation, Popovik, Bhatkar, Dekkar Pub.
6. Understanding Distributed Process Systems For Control, Samuel Herb, ISA.

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| Third Year B. Tech Instrumentation Engineering<br>Modern Control Theory | | | |
|---|---|---|---|
| **Course Code:** | **INPCC503** | **Credit** | **3** |
| **Contact Hours:** | 3 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examinatio nScheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

- **Pre-requisites:** Basic knowledge of Electrical & Electronics Engineering

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | Constructing State Space Models |
| 2 | Analyzing Control Systems |
| 3 | Evaluating Controllability, Observability, and Stability |
| 4 | Designing Control Systems using State Space |
| 5 | Understanding and Working with Sampled Data Control Systems |

| Course Outcomes: Students will be able to | |
|---|---|
| 503.1 | Construct state space models and represent dynamic systems |
| 503.2 | Analyze control systems using eigenvalues and eigenvectors |
| 503.3 | Evaluate controllability, observability, and stability |
| 503.4 | Design control systems using state space |
| 503.5 | Understand and work with sampled data control systems |
| 503.6 | Analyze sampled data control systems |

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| Topics covered: |
|---|
| **Unit I: INTRODUCTION TO STATE SPACE (6 hrs.)**<br>Terminology of State Space<br>**1.1 State Space Representation**<br>Describes a system using a set of first-order differential equations. Expressing the system's behavior in terms of state variables.<br>**1.2 Physical Variable State Space Representation**<br>Represents the system using physical variables (e.g., position, velocity) as state variables.<br>**1.3 Phase Variable Forms**<br>Companion Forms: Controllable Canonical Form and Observable Canonical Form.<br>Canonical Variable Forms: Diagonal Canonical Form and Jordan Canonical Forms.<br>Determination of Transfer Function from State Space Model: Deriving the transfer function that relates the input and output of the system based on its state space representation. |
| **Unit II: ANALYSIS OF CONTROL SYSTEM IN STATE SPACE (6 hrs.)**<br>**2.1Concept of Eigenvalues and Eigenvectors:**<br>Eigenvalues and eigenvectors are essential in analyzing the behavior of linear systems.<br>**2.2 Diagonalisation of Plant Matrix:**<br>Achieved through similarity transformations.<br>Involves the Vandermonde matrix.<br>**2.3Solution of Homogeneous State Equation:**<br>Finding the solution to the system's state equation when the input is zero.<br>**2.4State Transition Matrix:**<br>Definition, derivation, and properties.<br>Computation by Laplace transform method, Cayley Hamilton method, and similarity transformation method.<br>**2.5Solution of Non-homogeneous State Equation:**<br>Finding the solution when the system has a non-zero input. |
| **Unit III: CONTROLLABILITY, OBSERVABILITY, AND STABILITY (6 hrs.)**<br>**3.1Controllability and Observability:**<br>Definitions and matrices (Controllability matrix, Observability matrix).<br>Investigation using Kalman's test and Gilbert's test.<br>**3.2 Stability:**<br>Concepts of asymptotic stability and stability in the sense of Lyapunov.<br>Lyapunov stability analysis (direct method) of continuous-time LTI systems. |
| **Unit IV: DESIGN CONCEPTS IN STATE SPACE (6 hrs.)**<br>**4.1 State Variable Feedback:**<br>Utilizing state variables in feedback control systems.<br>**4.2Control System Design via Pole Placement:**<br>Necessary and sufficiency conditions.<br>Computation of state feedback gain matrix K through sufficiency condition, Ackermann formula, and coefficient comparison method.<br>**4.3State Observer:**<br>Necessity, types, theory. Principle of duality between state feedback gain matrix K and observer gain matrix Ke. Design of full-order state observer. |
| **Unit V: SAMPLED DATA CONTROL SYSTEMS (6 hrs.)**<br>**5.1Introduction to Discrete Time Control Systems:**<br>Basics of digital control systems.<br>**5.2Necessary for Digital Control System:** |

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Fundamental concepts needed for understanding and implementing digital control.

**5.3Block Diagram of Digital Control Systems:**
Visualization of digital control systems.

**5.4Operation and Equivalents of ADC and DAC:**
Analog-to-digital and digital-to-analog conversion processes.

**5.5Analytical Equivalent Block Diagram of Digital Control System:**
Representation of digital control systems in terms of mathematical blocks.

**5.6Sampling Theorem:**
Fundamental principle governing sampling. Sampling and Reconstruction Process: Fundamental processes in digital control systems.

**5.7Operation and Transfer Function of Zero-Order Hold:**
Representation and characteristics of zero-order hold in sampled data control systems.

**Unit VI: ANALYSIS OF SAMPLED DATA CONTROL SYSTEMS (6hrs.)**

**6.1Solution of Difference Equations using Z-Transforms Method:**
Applying Z-transforms to analyze and solve difference equations.

**6.2Pulse Transfer Function:**
Representation of discrete-time systems in terms of input and output signals.

**6.3Stability Analysis of Discrete Time Control Systems:**
Using Jury stability test, bilinear transformation, and Routh stability test to assess stability in discrete-time systems.

**Text Books:**

1. Control Systems Engineering Author : Nagrath and Gopal Publisher : New Age Publication
2. Modern Control Engineering Author : Katsuhiko Ogata Publisher : Prentice Hall of India
3. Modern Control System Author : Richarc C. Drof and Robert H. Bishop Publisher : 11th Edition Person Int.
4. Automatic Control Systems Author : Benjamin C.Kuo Publisher : Farid Golnaraghi, John Wiley &Sons.

**References Books:**

1. A. Nagoor Kani, Control System, RBA Publications.
2. M. Gopal , Digital Control & State Variable Methods, TMH..
3. M. Gopal, "Control Systems, Principles and Design", Second Edition, TMH, New Delhi, 2002.

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| Third Year B. Tech Instrumentation Engineering<br>Digital Signal Processing | | | |
|---|---|---|---|
| **Course Code:** | **INPCC504** | **Credit** | **04** |
| **Contact Hours:** | 3 Hrs/week (L)<br>1 Hr/week (T) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation<br>40 Marks | End-sem. Examination<br>60 Marks | |

- **Pre-requisites:** Signals & System, Engineering Mathematics.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To study the basics of signal processing. |
| 2 | To explain the various transforms for signal analysis. |
| 3 | To demonstrate interplay between time and frequency domain |
| 4 | To study the FIR and IIR filters. |

| Course Outcomes: Students will be able to | |
|---|---|
| 504.1 | Classify the signals and systems. |
| 504.2 | Apply z transform for signal analysis in frequency domain. |
| 504.3 | Compute the response of discrete-time systems to various input signals |
| 504.4 | Analyze the frequency domain characteristics of Discrete-Time Systems |
| 504.5 | Design IIR filters from appropriate specifications. |
| 504.5 | Select the FIR filter design algorithm as per the filter specifications. |

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| Topics covered: |
|---|
| **Unit I: Introduction to Discrete Time Signals and Systems (6 hrs.)**<br>Basic elements of Digital Signal Processing (DSP), analog to digital conversion (ADC), comparison between DSP and Analog Signal Processing (ASP) with applications of DSP. Discrete-time signals and systems: classification of signals, sampling theorem , classification of systems, input-output description of systems. |
| **Unit II: Analysis of Discrete-Time Systems (6 hrs)**<br>Linear convolution, causality and stability of discrete time systems, autocorrelation, cross correlation, Z-transform and its properties, transfer function, pole-zero plot. Implementation of discrete-time systems: Structures for the realization, |
| **Unit III: Frequency analysis of Discrete-Time Signals (6)**<br>Frequency response of LTI systems, Discrete-Time Fourier Series (DTFS) and Discrete Time Fourier Transform (DTFT) and , properties Energy density spectrum and power density spectrum |
| **Unit IV: Fast Fourier Transform. (6 hrs)**<br>Discrete Fourier transform (DFT), properties of DFT, circular convolution, linear filtering methods based on DFT, Fast Fourier Transform (FFT) algorithms: Radix-2 Decimation In-Time (DIT) and Decimation-In-Frequency (DIF) FFT algorithms. |
| **Unit V:Design of IIR filters (6 hrs)**<br>Introduction to analog IIR filters, Butterworth approximation, Chebyshev approximation. Design of digital IIR filter: impulse invariance method, bilinear transformation. |
| **Unit VI: : Design of FIR filters (6 hrs)**<br>Introduction to FIR filters, linear phase filters, symmetric and anti-symmetric filters, FIR design by Fourier approximation, window method, frequency sampling method, comparison between FIR and IIR filters. |

**Text Books:**

1. Proakis J. G and D. G. Manolakis, "Digital Signal processing, Principles, Algorithms and Applications", Prentice Hall of India.
2. Johnson J. R, "Introduction to Digital Signal Processing", Prentice Hall of India.
E. C. Ifeachor& B. W. Jarvis,
3. "Digital Signal Processing- A Practical Approach", Pearson Education,New Delhi

**References Books:**

1. S. K. Mitra, "Digital Signal Processing: A Computer based Approach", Tata McGraw Hill
Oppenheim A. V and R. W. Schafer, "Discrete Time Signal Processing", Pearson Education.

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| Third Year B.Tech Instrumentation Engineering<br>Web Technology | | | |
|---|---|---|---|
| **Course Code:** | **INPEC505A** | **Credit** | **03** |
| **Contact Hours:** | 3 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

**Pre-requisites:** Internet

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To explain basics of server side scripting using PHP |
| 2 | To familiarize various concepts of application development using JSP |
| 3 | To facilitate students to connect to databases using JDBC |
| 4 | To impart servlet technology for writing business logic |
| 5 | To explain web application development procedures |

| Course Outcomes: Students will be able to | |
|---|---|
| 505A.1 | Analyze the difference between and PHP and XML |
| 505A.2 | Create web pages using PHP |
| 505A.3 | Design web application using MVC architecture |
| 505A.4 | Understand the concept of JAVA SCRIPTS |
| 505A.5 | Identify the difference between the JSP and Servlet. |
| 505A.6 | Apply JDBC and ODBC technologies to create database connectivity |

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| Topics covered: |
|---|
| Unit I: **Web Basics and Overview(6 hrs)**<br>Introduction to Internet, World Wide Web, Web Browsers, URL, MIME, HTTP, Web Programmers Toolbox. HTML Common tags: List, Tables, images, forms, frames, Cascading Style Sheets (CSS) & its Types. Introduction to Java Script, Declaring variables, functions, Event handlers (onclick, onsubmit, etc.,) and Form Validation |
| Unit II: **Introduction to XML (6 hrs)**<br>Document type definition, XML Schemas, Presenting XML , Introduction to XHTML, Using XML Processors: DOM and SAX. PHP: Declaring Variables, Data types, Operators, Control structures, Functions |
| **Unit III: Web Servers and Servlets(6 hrs)**<br>Introduction to Servlets, Lifecycle of a Servlet, JSDK, Deploying Servlet, The Servlet API, The javax. Servlet Package, Reading Servlet parameters, Reading Initialization parameters. The javax. servlet HTTP package, Handling Http Request & Responses, Cookies and Session Tracking. |
| **Unit IV: JavaScript and jQuery: (7 hrs)**<br>Basics of JavaScript and Client-side scripting language, JavaScript syntaxes for variables, functions, branches and repetitions. JavaScript alert, prompt and confirm. Objects in JavaScript, Access/Manipulate web browser elements using DOM Structure, forms and validations, JavaScript events, Basics of jQuery, jQuery syntaxes, jQuery selectors |
| **Unit V: Topics and Contents Web Technology Frameworks: (6 hrs)**<br>Express Framework: Introduction to Express Framework, Getting Started with Express, First Express App, Express Routing, Implementing MVC in Express, Middleware, Using Template Engines, Error Handling |
| **Unit VI: JSP Application Development: (5 hrs)**<br>The Anatomy of a JSP Page, JSP Processing. JSP Application Design and JSP Environment, JSP Declarations, Directives, Expressions, Scripting Elements, implicit objects |

**Text Books:**

1. Web Programming, building internet applications, Chris Bates 2nd edition, WILEY Dreamtech
2. Core Servlets Andjavaserver Pages Volume 1: Core Technologies, By Marty Hall and Larry Brown Pearson

**References Books:**

1. Programming world wide web-Sebesta, Pearson Education,2007.
2. Internet and World Wide Web – How to program by Dietel and Nieto PHI/ Pearson EducationAsia.
3. Jakarta Struts Cookbook, Bill Siggelkow, S P D O' Reilly for chap8
4. March's beginning JAVA JDK Murach,SPD
5. An Introduction to WEB Design and Programming –Wang-Thomson
6. PHP: The Complete Reference Steven Holzner TataMcGraw-Hill.

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| Third Year B. Tech Instrumentation Engineering<br>Programming Practices JAVA | | | |
|---|---|---|---|
| **Course Code:** | **INPCC505B** | **Credit** | **03** |
| **Contact Hours:** | 2 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

**Pre-requisites:** Digital Electronics, Basic Electronics Engineering, Operating System.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | Understand the fundamentals of Java programming, including syntax, data types, and control structures. |
| 2 | Apply Object-Oriented Programming (OOP) principles to develop modular, reusable, and maintainable Java applications. |
| 3 | Work with file handling, I/O streams, and serialization for data processing. |
| 4 | Elobrate multithreaded applications to handle concurrent programming scenarios. |
| 5 | Establish database connectivity using JDBC to perform CRUD operations. |
| 6 | Build and deploy a real-world Java project using industry practices. |

| Course Outcomes: Students will be able to | |
|---|---|
| 505B.1 | Write efficient and readable Java code using proper coding conventions and best practices |
| 505B.2 | Apply OOP principles such as encapsulation, inheritance, polymorphism, and abstraction in Java programs. |
| 505B.3 | Perform file handling operations and manage data persistence using serialization. |
| 505B.4 | Develop multithreaded applications to handle concurrency and parallelism in Java. |
| 505B.5 | Establish database connectivity using JDBC to interact with relational databases |
| 505B.6 | Design and implement a real-world Java application, incorporating best programming practices and optimization techniques. |

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| Topics covered: |
|---|
| **Unit I: Introduction to Java Programming: (07 hrs)**<br>Java Overview: Features and Benefits, Setting up the Java Development Environment (JDK, IDEs: IntelliJ, Eclipse, NetBeans), Writing, Compiling, and Running Java Programs, Java Data Types, Variables, Operators, and Control Statements, Best Practices for Code Readability and Maintainability. |
| **Unit II: Object-Oriented Programming (OOP) in Java: (07 hrs)**<br>Fundamentals of OOP: Classes, Objects, Methods, Constructors, Method Overloading, and Encapsulation, Inheritance and Method Overriding, Polymorphism: Static and Dynamic, Abstraction and Interfaces, Best Practices for Writing Reusable and Modular Code. |
| **Unit III: Exception handling & IO package: (07 hrs)**<br>Exception handling: Exception as objects, Exception hierarchy, Try catch finally Throw, throws, IO package: Input streams. Output streams, Object serialization, Deserialization, Sample programs on IO files Filter and pipe streams. |
| **Unit IV: File Handling and I/O Streams: (07 hrs)**<br>Reading and Writing Files in Java (File Reader, File Writer, Buffered Reader), Byte Streams vs. Character Streams, Serialization and Deserialization, Working with Properties Files. Handling Large Files Efficiently. |
| **Unit V: Multithreading and Concurrency: (06 hrs)**<br>Understanding Threads and Concurrency, Thread Lifecycle and Thread Methods, Creating and Managing Threads (Runnable Interface, Thread Class), Synchronization and Inter-Thread Communication, Java Concurrent API (Executors, Callable, Future). |
| **Unit VI: GUI Introduction & Database Connectivity: (06 hrs)**<br>GUI Introduction to AWT programming Layout and component managers Event handling Applet class Applet life-cycle Passing parameters embedding in HTML 3 Swing components – JApplet, JButton, JFrame, etc. Sample swing programs.<br>Database Connectivity JDBC architecture Establishing connectivity and working with connection interface Working with statements. |

**Text Books:**

1. JavaFundamentals–AComprehensiveIntroduction,HerbertSchildtandDaleSkrien,TMH.
2. Core Java: An Integrated Approach – Dr R NageswaraRao

**References Books:**

1. Java for Programmers, P.J.Deitel and H.M.Deitel, PEA (or) Java: How to Program , P.J.Deitel and H.M.Deitel,PHI
2. ObjectOrientedProgrammingthroughJava,P.RadhaKrishna,UniversitiesPress.
3. Thinking in Java, Bruce Eckel,PE
4. Programming in Java, S. Malhotra and S. Choudhary, Oxford UniversitiesPress.
5. Design Patterns Erich Gamma, Richard Helm, Ralph Johnson and JohnVlissides

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| Third Year B. Tech Instrumentation Engineering<br>Biomedical Instrumentation | | | |
|---|---|---|---|
| **Course Code:** | **INPCC505C** | **Credit** | **03** |
| **Contact Hours:** | 2 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

**Pre-requisites:** Digital Electronics, Basic Electronics Engineering, Operating System.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To understand the anatomy of various systems in human body. |
| 2 | To learn the all types of Bio electrodes and measurement techniques |
| 3 | To acquire the skill to handling the biomedical equipment's. |
| 4 | To understand the component and working of biomedical equipments |

| Course Outcomes: Students will be able to | |
|---|---|
| 505C.1 | To understand the anatomy of various systems in human body. |
| 505C.2 | Select and apply the appropriate bioelectrode for measurement of physiological parameters. |
| 505C.3 | Demonstrate his/her skills by using biomedical equipment's. |
| 505C.4 | Explain the function of instruments and its working |
| 505C.5 | Learn upcoming technology through continuous learning in biomedical instrumentation field. |

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| Topics covered: |
|---|
| **Unit I: Bio-potential Measurement: (07 hrs)**<br>Electrode-Electrolyte interface, half-cell potential, Polarization- polarisable and nonpolarizable electrodes, Ag/AgCl electrodes, Electrode circuit model; motion artifact. Body Surface recording electrodes for ECG, EMG, and EEG. Internal electrodes- needle and wire electrodes. Micro electrodes- metal microelectrodes, Electrical properties of microelectrodes. Electrodes for electric stimulation of tissue Bio-transducers: Physiological parameters & suitable transducers for its measurements, operating principles & specifications for the transducers to measure parameters |
| **Unit II: Cardiovascular System: (07 hrs)**<br>Heart Structure, Cardiac Cycle, ECG Theory, ECG Electrodes, Electrocardiograph, Vector cardiograph Analog Signal Processing of Bio-signals, Amplifiers, Transient Protection, Interference Reduction, Movement Artifact Circuits, Active Filters, Rate Measurement, Averaging and Integrator Circuits, Transient Protection Circuits |
| **Unit III: Cardiovascular Measurements: (07 hrs)**<br>Heart Sounds, Phonocardiography, Blood Pressure Measurement (Invasive and Noninvasive), Blood Flow meters: Magnetic, Ultrasonic, Thermal Convection Methods, Cardiac Output Measurement (dye dilution method), Plethysmography |
| **Unit IV: Central Nervous System : (07 hrs)**<br>Brain & its parts, different waves from different parts of the brain, brain stem, cranium nerves, structure of neuron, Neuro muscular transmission, Electroencephalography, Evoked Response, EEG amplifier, Biofeedback Classification of muscles: Muscle contraction mechanism, Myoelectric voltages, Electromyography (EMG). |
| **Unit V: Special Senses: (06 hrs)**<br>I Ear: Mechanism of Hearing, Sound Conduction System, Basic Audiometer; Pure tone audiometer; Audiometer system Bekesy; Evoked response Audiometer system, Hearing Aids II Vision: Anatomy of Eye, Visual acuity, (Errors in Vision,) |
| **Unit VI: Respiratory Instrumentation: (06 hrs)**<br>Natural Process of Breathing, O2 and CO2 Transport, Regulation of Breathing, Spirometers, airflow measurement, Oxygenators-Bubble Type, Membrane Type Gas Analyze |

**Text Books:**

1. Human Physiology- The Mechanism of Body Function By Vander, Sherman, TMH Ed.1981.
2. Introductions to Biomedical Equipment Technology By Joseph J. Carr & John M. Brown, Publisher, Pearson Education,
3. Biomedical Instrumentation and Measurements By Leslie Cromwell, Fred J. Weibell , 2nd edition, Prentice Hall India Learning Private Limited;.
4. Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH

**References Books:**

3. Biomedical Digital Signal Processing, Tompkins, PHI .
4. Biomedical Instrumentation, Dr. M. Arumugam , Anuradha Publications,
5. Text book of clinical Ophthalmology- Ronald Pitts Crick, Pang Khaw, 2nd Edition, World Scientific publication. ISBN 981-238-128-7

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| Third Year B. Tech Instrumentation Engineering<br>Automation in Production System and Management | | | |
|---|---|---|---|
| **Course Code:** | INOEC506 | **Credit** | **03** |
| **Contact Hours:** | 03 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

**Pre-requisites:** Nil

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | External | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | Learn the automation in manufacturing system |
| 2 | Explore the process of production process planning |

| Course Outcomes: Students will be able to | |
|---|---|
| 506.1 | Illustrate the various automation processes |
| 506.2 | Describe the software and hardware tools for the production processing planning |

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| Topics covered: | | |
|---|---|---|
| Week 1 | : | Introduction to Manufacturing and Production Systems |
| Week 2 | : | Automation in Manufacturing and Production Systems |
| Week 3 | : | Product Development Process and Automation |
| Week 4 | : | Fundamentals of NC Technology: Part-I |
| Week 5 | : | Fundamentals of NC Technology: Part-II |
| Week 6 | : | Flexible and Programmable Automation |
| Week 7 | : | Cellular Manufacturing Systems |
| Week 8 | : | Flexible Manufacturing Systems: Part-I |
| Week 9 | : | Flexible Manufacturing Systems: Part-II |
| Week 10 | : | Fundamentals of Robotic Systems |
| Week 11 | : | Automated CAPP (Part-I) |
| Week 12 | : | Automated CAPP (Part-II) |

**MOOC:** Automation In Production Systems and Management:

**https://onlinecourses.nptel.ac.in/noc24_mg117/preview**

**Books and references**

1. Groover, M P, Automation, Production Systems, and Computer Integrated Manufacturing, Third Edition, Pearson Prentice Hall, Upper Saddle River
2. Groover, M P and Zimmers, E W Jr, CAD/CAM: Computer-aided Design and Manufacturing, Prentice-Hall of India Private Ltd.

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| Third Year B. Tech Instrumentation Engineering<br>Industrial Automation Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPCC507** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (P) | **Type of Course:** | Practical |
| **Examinatio nScheme** | Practical<br>50 Marks | | |

- **Pre-requisites:** Sensors and Transducers, Digital Techniques, Process Control Loop Components

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Practical | Externa l | 50 |

| Course Objectives | |
|---|---|
| 1 | To introduce the basics of PLC, HMI, and DCS |
| 2 | To explain ladder programming using advanced PLC instructions |
| 3 | To describe interfacing of analog and digital devices with PLC |
| 4 | To explain the configuration, operation and programming of DCS |

| Course Outcomes: Students will be able to | |
|---|---|
| 507.1 | Understand the fundamentals of PLC, PLC interfacing and HMI. |
| 507.2 | Develop HMI/SCADA system for given applications. |
| 507.3 | Describe the software and hardware DCS configuration. |
| 507.4 | Explain DCS operation and integration. |
| 507.5 | Develop FBD program for automation and explain advanced techniques in DCS |
| 507.6 | Explain various DCS applications. |

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**List of Experiments:**

Students are required to perform minimum 10 experiments from the given list.

1. Develop Human machine interface(HMI) for lamp ON/OFF using PLC
2. Develop Human machine interface (HMI) for graph/chart representation using PLC.
3. Develop and Simulate Ladder program for one application of Analog in/Analog out.
4. Develop and Simulate Ladder program for PID controller using PLC for Level/Flow/Temp Control Systems.
5. Interfacing PLC to hydraulic & Pneumatic circuits.
6. To study the detail architecture of any typical DCS system
7. Develop FBD for truth table verification of logic gates
8. To start and stop LED using DCS
9. To connect field device and its configuration for input and output channels in DCS
10. Develop FBD to understand alarm activation in DCS
11. To prepare specification sheet of DCS for any industrial application.
12. Creating and configuring a project and tags in SCADA.
13. Case study of DCS for any cloud based Industrial application.
14. Case study of DCS integration with ERP for optimized operations in a Water Treatment Plant.

**Virtual lab:**

15. Study, understand and perform experiments on timers and counters used in DCS.
16. Logic implementation for Bottle Filling Application.
17. Tune PID controller for heat exchanger using DCS
18. Develop graphical user interface for the fermenter plant

**Text Books:**

1. Programmable Logic Controllers: Principles & Applications by John W. Webb, Ronald A. Reis, Prentice Hall of India, 5th ed.
2. Introduction to Programmable Logic Controllers by Gary Dunning, Delmar Thomson Learning, 3rd ed.
3. Krishna Kant, Computer-based Industrial Control, Prentice Hall, New Delhi, 1997.
4. Computer aided process control, S. K. Singh, PHI.

**References Books:**

1. Programmable Logic Controller by Frank D Petruzella, McGraw-Hill Education, 5th ed.
2. Programmable Logic Controllers by W. Bolton, Elsevier Newness publication, 4th ed.
3. Programmable Controller by T. A. Huges, ISA publication, 2nd ed.
4. SCADA by Stuart A. Boyer, ISA 1999.
5. Distributed computer control for industrial automation, Popovik, Bhatkar, Dekkar Pub.
6. Understanding Distributed Process Systems For Control, Samuel Herb, ISA.

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| Third Year B. Tech Instrumentation Engineering<br>Modern Control Theory Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPCC508** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (P) | **Type of Course:** | Practical |
| **Examinatio nScheme** | Practical<br>50 Marks | | |

**Pre-requisites:**

- Basic knowledge of Mathematics , Electrical & Electronics Engineering

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Practical | External | 50 |

| Course Objectives | |
|---|---|
| 1 | Develop proficiency in computing the state transition matrix using various techniques, such as Laplace transform, Cayley Hamilton method, and similarity transformation. |
| 2 | Students can gain practical experience in applying theoretical concepts of control systems analysis and design to real-world problems |

| Course Outcomes: Students will be able to | |
|---|---|
| 508.1 | Improved understanding of transient and steady-state behavior of electrical networks |
| 508.2 | Ability to evaluate and compare control system performance |
| 508.3 | Proficiency in root locus analysis for stability assessment |
| 508.4 | Ability to converting between transfer function and state space models |
| 508.5 | Proficiency with state feedback control design |
| 508.6 | Competence in designing state observers and implementing state feedback |

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**List of Experiments:**

Students are expected to perform any 8 experiments.
Study of Step Response of R-L Network
2. Study of Step Response of R-C Network
3 Study of Time Response of R-L-C Network
4. Study of first and second order system response..
5. Find steady state error of type 0,1,2 system.
6. Stability analysis using root locus approach
7. Conversion of transfer function model to state space and vice-versa..
8. Computation of state transition matrix using different methods
9. Design a state feedback controller through pole placement approach..
10. Design full order state observer using principle of duality.
11. Stability analysis of Lypunuv Functions.
12. VLAB: Find the Response of the discrete time control system for standard inputs.
13. VLAB: Determine effect of sampling period on stability of discrete time control system.

**Text Books:**


5. Control Systems Engineering Author : Nagrath and Gopal Publisher : New Age Publication
6. Modern Control Engineering Author : Katsuhiko Ogata Publisher : Prentice Hall of India
7. Modern Control System Author : Richarc C. Drof and Robert H. Bishop Publisher : 11th Edition Person Int.
8. Automatic Control Systems Author : Benjamin C.Kuo Publisher : Farid Golnaraghi, John Wiley &Sons.


**References Books:**


4. A. Nagoor Kani, Control System, RBA Publications.
5. M. Gopal , Digital Control & State Variable Methods, TMH..
6. M. Gopal, "Control Systems, Principles and Design", Second Edition, TMH, New Delhi, 2002.


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| Third Year B.Tech Instrumentation Engineering<br>Web Technology Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPEC509A** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (P) | **Type of Course:** | Practical |
| **Examination Scheme** | Oral examination<br>50 Marks | | |

**Pre-requisites:Nil**

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Oral | External | 50 |

| Course Objectives | |
|---|---|
| 1 | To explain basics of server side scripting using PHP |
| 2 | To explain web application development procedures |

| Course Outcomes: Students will be able to | |
|---|---|
| 509A.1 | Analyze the difference between and PHP and XML |
| 509A.2 | Understand the concept of HTML |

**List of Experiments:**

Students are required to perform minimum 08 experiments from the given list.

1. Design a web page to demonstrate the use of different HTML5 tags.
2. Create HTML Page with JavaScript which takes Integer number as input and tells whether the number is ODD or EVEN.
3. Design a web page to demonstrate the use of CSS3 tags.
4. Create XML file to store student information like Enrollment Number, Name , Mobile Number , Email Id.
5. Develop a JavaScript to display today's date.
6. Write a php program to display today's date in dd-mm-yyyy format.
7. Write a php program to print first 10 Fibonacci Numbers.
8. Design a simple application using Express framework.
9. To demonstrate working of HTML code and create basic HTML pages using proper syntax.
10. Applying attributes in HTML tags
11. VLAB: Demonstrate working of HTML code and create basic HTML pages using proper syntax.
12. VLAB: Embedding through iframe Tag

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**Text Books:**

1. Web Programming, building internet applications, Chris Bates 2nd edition, WILEY Dreamtech

2. Core SERVLETS ANDJAVASERVER PAGES VOLUME 1: CORE TECHNOLOGIES By Marty Hall and Larry Brown Pearson

**References Books:**

1. Programming world wide web-Sebesta, Pearson Education,2007.

2. Internet and World Wide Web – How to program by Dietel and Nieto PHI/ Pearson EducationAsia.

3. Jakarta Struts Cookbook, Bill Siggelkow, S P D O' Reilly for chap8

4. March's beginning JAVA JDK Murach,SPD

5. An Introduction to WEB Design and Programming –Wang-Thomson

6. PHP: The Complete Reference Steven Holzner TataMcGraw-Hill.

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| Third Year B.Tech Instrumentation Engineering<br>Programming Practice JAVA Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPCC509B** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (P) | **Type of Course:** | Practical |
| **Examination Scheme** | Oral examination 50 Marks | | |

**Pre-requisites:**

- Nil

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Oral | External | 50 |

| Course Objectives | |
|---|---|
| 1 | Understand the fundamentals of Java programming, including syntax, data types, and control structures. |
| 2 | Apply Object-Oriented Programming (OOP) principles to develop modular, reusable, and maintainable Java applications. |
| 3 | Work with file handling, I/O streams, and serialization for data processing. |
| 4 | Elobrate multithreaded applications to handle concurrent programming scenarios. |
| 5 | Establish database connectivity using JDBC to perform CRUD operations. |
| 6 | Build and deploy a real-world Java project using industry practices. |

| Course Outcomes: Students will be able to | |
|---|---|
| 509B.1 | Write efficient and readable Java code using proper coding conventions and best practices |
| 509B.2 | Apply OOP principles such as encapsulation, inheritance, polymorphism, and abstraction in Java programs. |
| 509B.3 | Perform file handling operations and manage data persistence using serialization. |
| 509B.4 | Develop multithreaded applications to handle concurrency and parallelism in Java. |
| 509B.5 | Establish database connectivity using JDBC to interact with relational databases |
| 509B.6 | Design and implement a real-world Java application, incorporating best programming practices and optimization techniques. |

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## List of Experiments:

Students are required to perform minimum 06 module from the given list.

**Module 1: Java Basics**

1. **Simple Java Program** – Write, compile, and execute a Java program that prints "Hello, Java!".
2. **Basic Data Types and Operators** – Implement a program to perform arithmetic, relational, and logical operations.
3. **Control Statements** – Develop a Java program using if-else, switch-case, and loops (for, while, do-while).

**Module 2: Object-Oriented Programming (OOP) in Java**

4. **Class and Object Implementation** – Create a class Student with attributes and methods, then instantiate objects.
5. **Constructors and Method Overloading** – Implement a program demonstrating constructor overloading.
6. **Inheritance and Method Overriding** – Develop a program using single and multilevel inheritance.
7. **Abstraction and Interfaces** – Create an interface Vehicle and implement it in different classes.
8. **Polymorphism** – Demonstrate method overloading and overriding with real-world examples.

**Module 3: Exception Handling and Debugging**

9. **Exception Handling** – Write a Java program to demonstrate try-catch, finally, and multiple catch blocks.
10. **Custom Exception** – Implement user-defined exceptions for invalid user input.

**Module 4: Java Collections Framework (JCF)**

11. **ArrayList and LinkedList** – Create and manipulate an ArrayList and LinkedList with CRUD operations.
12. **HashSet and TreeSet** – Implement a program to demonstrate the properties of HashSet and TreeSet.
13. **HashMap and TreeMap** – Develop a Java program using HashMap for key-value storage.

**Module 5: File Handling and I/O Streams**

14. **File Reading and Writing** – Write a Java program to read and write text files using FileReader and FileWriter.
15. **BufferedReader and BufferedWriter** – Implement a program for efficient file handling with BufferedReader.
16. **Serialization and Deserialization** – Demonstrate object serialization and deserialization.

**Module 6: Multithreading and Concurrency**

17. **Thread Creation (Extending Thread Class)** – Implement a program to create multiple threads using the Thread class.
18. **Thread Creation (Implementing Runnable Interface)** – Write a Java program using the Runnable interface.
19. **Thread Synchronization** – Demonstrate synchronization in multithreading using a shared resource.
20. **Executor Framework** – Use ExecutorService to manage multiple threads efficiently.

**Module 7: Java Database Connectivity (JDBC)**

21. **Database Connection** – Establish a connection to MySQL/PostgreSQL using JDBC.
22. **Perform CRUD Operations** – Implement INSERT, SELECT, UPDATE, and DELETE operations using JDBC.
23. **PreparedStatement vs. Statement** – Demonstrate the use of PreparedStatement for SQL queries.

**Module 8: GUI Development (Optional)**

27. **Swing Application** – Develop a simple Java Swing GUI for a login form.
28. **JavaFX Application** – Create a JavaFX-based UI application for a student management system.

9.VLAB: Using constructors to create objects

10.VLAB: Learning of Encapsulation through Package

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**Text Books:**

**6.** JavaFundamentals–AComprehensiveIntroduction,HerbertSchildtandDaleSkrien,TMH.

**7.** Core Java: An Integrated Approach – Dr R NageswaraRao

**References Books:**

6. Java for Programmers, P.J.Deitel and H.M.Deitel, PEA (or) Java: How to Program , P.J.Deitel and H.M.Deitel,PHI
7. ObjectOrientedProgrammingthroughJava,P.RadhaKrishna,UniversitiesPress.
8. Thinking in Java, Bruce Eckel,PE
9. Programming in Java, S. Malhotra and S. Choudhary, Oxford UniversitiesPress.
10. Design Patterns Erich Gamma, Richard Helm, Ralph Johnson and JohnVlissides.

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| Third Year B. Tech Instrumentation Engineering<br>Biomedical Instrumentation Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPCC509C** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week<br>(P) | **Type of Course:** | Practical |
| **Examination Scheme** | Oral examination<br>50 Marks | | |

**Pre-requisites:**

- Digital Electronics, Basic Electronics Engineering, Operating System..

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Oral | External | 50 |

| Course Objectives | |
|---|---|
| 1 | To learn the all types of Bio electrodes and measurement techniques |
| 2 | To acquire the skill to handling the biomedical equipment's. |

| Course Outcomes: Students will be able to | |
|---|---|
| 509C.1 | select and apply the appropriate bioelectrode for measurement of physiological parameters. |
| 509C.2 | demonstrate his/her skills by using biomedical equipment's. |
| 509C.3 | explain the function of instruments and its working |

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**List of Experiments:**

Students are required to perform minimum 08 experiments from the given list.

1. To study bio electrodes.
2. To study various preamplifier used in biomedical applications.
3. To Design a Notch Filter for Power Line Frequency.
4. To study Electrocardiogram
5. To Measure Blood Pressure Using Sphygmomanometer, Calibration of BP apparatus
6. To Implement a Heart Rate Meter.
7. To study Phonocardiogram.
8. To study Electro surgical Unit.
9. To Study Electroencephalogram (EEG)/ Electromyogram (EMG )
10. To study of Audiometer.
11. To study of spirogram.
12. To study Bio Bench.
13. To study Power lab.
14. VLAB:Monitoring of Electrocardiogram (ECG) for chest leads V1-V6
15. VLAB:Monitoring of Electroencephalogram (EEG) signal for different lobes

**Text Books:**

5. Human Physiology- The Mechanism of Body Function By Vander, Sherman, TMH Ed.1981.
6. Introductions to Biomedical Equipment Technology By Joseph J. Carr & John M. Brown, Publisher, Pearson Education,
7. Biomedical Instrumentation and Measurements By Leslie Cromwell, Fred J. Weibell , 2nd edition, Prentice Hall India Learning Private Limited;.
8. Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH

**References Books:**

8. Biomedical Digital Signal Processing, Tompkins, PHI .
9. Biomedical Instrumentation, Dr. M. Arumugam , Anuradha Publications,
10. Text book of clinical Ophthalmology- Ronald Pitts Crick, Pang Khaw, 2nd Edition, World Scientific publication. ISBN 981-238-128-7

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| Third Year B. Tech Instrumentation Engineering<br>Foreign Language Level-I German | | | |
|---|---|---|---|
| **Course Code:** | IOHSM5ACA | **Credit** | **1** |
| **Contact Hours:** | 1 Hrs/week (P) | **Type of Course:** | Lecture |
| **Examinatio nScheme** | Term Work 25 Marks | | |

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Termwork | Internal | 25 |

| Course Objectives | |
|---|---|
| 1 | To get introduced to the Culture, Routine of the German Society through language. |
| 2 | To meet the needs of ever growing German industry with respect to language support. |

| Course Outcomes: Students will be able to | |
|---|---|
| 5ACA.1 | Use German language for basic communication. |
| 5ACA.2 | Apply the knowledge of German script. |
| 5ACA.3 | Read, write and improve their listening skills. |
| 5ACA.4 | Grasp the basic sentence structure and build a good foundational vocabulary. |

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**Topics covered:**

**Unit I: Introduction to the German Language-I (6 hrs)**

Introduction of German Alphabets,

- Spell the names
- Addresses
- Numbers,
- Telephone numbers
- Ordinal Numbers
- Pin code Numbers
- Dates
- Birthdates
- Age
- days of the week
- Months

**Unit II: Introduction to the German Language-II (6 hrs)**

- Basic Greetings
- Personal Pronouns
- Possessive Pronouns
- Self-Introduction
- Introducing other people, about family, friends, course mates
- Introduction to seasons, and seasons in Germany and in neighboring countries.

**Text Books:**

1. "Netzwerk A-1 (Deutsch als Fremdsprache) " Goyal Publishers & Distributors Pvt. Ltd

**Reference Books:**

1. Tipps und Uebungen A1

**Online Resources:**

1. Practice Material like Listening Module, reading Texts
2. Nptel Course On German -I Language

Online German-English Dictionary www.Leo.Org

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| Third Year B. Tech Instrumentation Engineering<br>Foreign Language Japanese Level I- Japanese | | | |
|---|---|---|---|
| **Course Code:** | **IOHSM5ACB** | **Credit** | **1** |
| **Contact Hours:** | **01Hr/Week** | **Type of Course:** | **Lecture** |
| **Examination scheme:** | **Term-work 25 marks** | | |

**Pre-requisites:**
Nil

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Term Work | Internal | 25 |

**Course Objectives**

| | |
|---|---|
| 1 | To meet the needs of an ever growing industry with respect to language support. |
| 2 | To get introduced to Japanese society and culture through language. |

**Course Outcomes: Students will be able to**

| | |
|---|---|
| 5ACB.1 | Demonstrate basic communication skills. |
| 5ACB.2 | Show knowledge of Japanese script. |
| 5ACB.3 | Apply skills to reading, writing and listening |
| 5ACB.4 | Develop interest to pursue professional Japanese Language courses. |

**Topics covered:**

**UNIT I Introduction to Japanese Language (6 hrs.)**
Introduction to Japanese Language and scripts (Hiragana, Katakana, and Kanji), Basic greetings.
Hiragana: Modified Kana, Double consonant, Letters combined with ya, yu, yo,
Long vowels, extended greetings and expression.
Self-Introduction: Introducing another person, Numbers, Months, Dates (asking and telling birthday), Telephone numbers, Stating one's age, days of the week. Audio learning

**UNIT II: Katakana ,Time and Transport Basics (6 hrs.)**
Katakana basic Script, Denoting things (nominal & prenominal demonstratives) Purchasing at the Market / in a shop / mall (asking & stating price).
Introduction to counters - Part 1
Katakana: Modified kana, double consonant, letters with ya, yu, yo, Long vowels.
Describing time, describing starting & finishing time (kara~made) Point in time (denoting the time when any action or the movement occurs)
Means of transport (Vehicles), Places, Countries, Indicating movement to a certain place by a vehicle. Audio learning

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**Text Books:**

1 Minna No Nihongo, "Japanese for Everyone", Elementary Main Textbook 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd

**Reference Books:**

1. George Trombley, Yukari Takenaka "Japanese from Zero!" Learn From Zero Publisher

**MOOC/NPTEL courses:**

1. NPTEL Course on "**Japani Bhasha –Saral Swaroop (Japanese course taught in Hindi)** "
Link of the Course: **https://onlinecourses.nptel.ac.in/noc23_hs76/preview**

2. **NPTEL Course on"** Introduction to Japanese Language and Culture"
Link of the Course :https://onlinecourses.nptel.ac.in/noc19_hs52/preview

**Guidelines for Assessment (Any one of following but not limited to)**

- Written Test
- Presentation
- Report

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| Third Year B. Tech Instrumentation Engineering<br>Seminar and Technical Paper writing | | | |
|---|---|---|---|
| **Course Code:** | **IOHSM601** | **Credit** | **02** |
| **Contact Hours:** | 01 Hr/Week(L)<br>02 Hrs/Week(P) | **Type of Course:** | Lecture /Practical |
| **Examination Scheme** | Termwork-50 marks | | |

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Termwork | Internal | 50 |

| Course Objectives | |
|---|---|
| 1 | To prepare students to communicate effectively as professionals. |
| 2 | To train students to use visual aids effectively |
| 3 | To implant technical writing skills |
| 4 | To develop presentation and technical writing skill |

| Course Outcomes: Students will be able to | |
|---|---|
| 601.1 | Analyze communication-related problems and improve communication skill. |
| 601.2 | Use various types of technical communication as per need |
| 601.3 | Write proposals and reports |
| 601.4 | Develop key skills in research, dissemination and documentation |

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| Topics covered: |
|---|
| **Unit I: Technical Communication : Oral (6 hrs.)**<br>Basics of Technical Communication, different forms of communication and advanced communication skills, dynamics of professional presentations , group discussions, etiquettes and mannerisms, job interviews (online/offline mode), public speaking, oral presentation. |
| **Unit II: Technical Communication : Written (6 hrs.)**<br>Technical proposal, technical writing: efficient process to create a report, research paper, report writing and documentation style-LaTex, use of visual aids, ethics in writing using plagiarism tools, resume writing. |

**Text Books:**


1. Sunita Mishra, "Communication Skills for Engineers" Pearson Education
2. Prof. K. R. Laxminarayanan and Dr. T. Murugavel "Communication Skills for Engineers" SCITECH.
3. Sharon J Gerson and Steven Gerson "Technical Writing – Process& Product", Pearson Education.
4. Danial Riordan, Steven E. Pauley Technical Report Writing Today
5. Krishna Mohan, Meera Banerji "Developing Communication skills", Laxmi Publications.
6. Meenakshi Raman and Sangeeta Sharma," Technical Communication Principles and Practice", Oxford University Press.


**References Books**


1. Sanjay Kumar and Pushp Lata, "Communication Skills" Oxford University Press.
2. Davies J.W. "Communication for engineering students", Longman
3. Eisenberg, "Effective Technical Communication", Mc. Graw Hill.
4. Robert A. Day, "How To Write and Publish a Scientific Paper", Fifth Edition, Oryx Press, Phoenix, AZ, 1998.


**List of Assignments / Activities :**

**Any eight of the following**

1. Introduction to technical communication
2. Group Discussion
3. Official/Public Speaking
4. Communication ethics
5. Conversational skills for job interviews
6. Theme based seminar/ oral presentation /poster presentation
7. Writing ethics-letter of application, resume e-mails.
8. Develop proposal in LaTex for selected research project

   Publication process: How to write and submit paper for conference, journal, the evaluation process, how to communicate with the editors, copyright, plagiarism.

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| Third Year B.Tech Instrumentation Engineering<br>Industrial Data Exchange | | | |
|---|---|---|---|
| **Course Code:** | **INPCC602** | **Credit** | **04** |
| **Contact Hours:** | 3 Hrs/week (L)<br>1 Hr/week (T) | **Type of Course:** | Lecture &<br>Tutorial |
| **Examination Scheme** | In-sem.<br>Evaluation<br>40 Marks | End-sem.<br>Examination<br>60 Marks | |

**Pre-requisites**: Industrial automation.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To introduce the basic components of networking and network topologies. |
| 2 | To provide details on OSI-ISO and TCP/IP network models. |
| 3 | To expose students to various data communication protocols. |
| 4 | To introduce network diagnostic and health monitoring tools. |

| Course Outcomes: Students will be able to | |
|---|---|
| 602.1 | Differentiate various network components and network topologies. |
| 602.2 | Identify OSI-ISO, TCP/IP network models. |
| 602.3 | Explain the architecture, applications, advantages and limitations of HART, Foundation Fieldbus and ProfiBus protocols. |
| 602.4 | Explain the architecture, applications, advantages and limitations of Ethernet and OPC protocols. |
| 602.5 | Explain the architecture, applications, advantages and limitations of Device Net, Control Net, BacNet protocols. |
| 602.6 | Explain the types and need of network diagnostic and health monitoring tools. |

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| Topics covered: |
|---|
| **Unit I: Introduction to Industrial Communication (6 hrs.)**<br>Introduction to ISA 95 Communication Pyramid<br>**Network Components:** Types and applications of Cables, Connectors, Switches, Hub, Router, Protocol Translators, Edge Devices, Repeaters, Firewall.<br>**Network Topology**: Working principles and applications of STAR Topology, Mesh Topology, BUS Topology, Ring Topology |
| **Unit II: Reference models and Protocols (8 hrs.)**<br>Basics of Protocol and its need, Purdue model<br>**Reference Models**: Brief functional description of OSI-ISO Reference Model, TCP/IP Reference Model<br>**Communication Standards**: RS232, RS422, RS485 interface standard, their comparison<br>**Modbus:** (ASCII/RTU), MODBUS protocol structure -function codes |
| **Unit III: HART, Foundation Fieldbus and ProfiBus (8 hrs.)**<br>**HART**: Concept of Highway Addressable Remote Transducer (HART), HART and smart Instrumentation, frame structure, programming, implementation examples, benefits, advantages and limitation, Troubleshooting.<br>**Foundation Fieldbus:** Introduction, characteristics, variants, frame structure, programming, implementation examples, benefits, advantages and limitations<br>**ProfiBus:** Introduction, architecture, variants, it's location, advantages, disadvantages, physical layer and wiring, applications. |
| **Unit IV: Ethernet and OPC (7 hrs.)**<br>**Ethernet:** Industrial Ethernet, Introduction, packet formats of Ethernet, Overview and comparison of ¸Mbps Ethernet, Fast Ethernet, Gigabit Ethernet, Introduction of CC link, Ethercat, Powerlink.<br>**OPC:** Concept of OPC (Object linking and embedding for Process Control), OPC UA Protocol, Introduction, Frame Structure, Implementation Examples |
| **Unit V: Device Net, Control Net, BacNet (7 hrs.)**<br>**Device Net**: Introduction, Frame Structure, Implementation Examples, advantages, disadvantages<br>**Control Net:** Introduction, Frame Structure, Implementation Examples, advantages, disadvantages<br>**BacNet:** Introduction, Frame Structure, Implementation Examples, advantages, disadvantages |
| **Unit VI: Network Diagnostic & Health Monitoring (6 hrs.)**<br>Good Networking Practices, Network health Monitoring, Network Diagnostics. Introduction to Various Tools : Wireshark, Packetsniffer |

**Text Books:**


1. Practical Industrial Data Networks: Design, Installation and Troubleshooting
   by Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Newnes Publication, Elsevier First Edition, 2004
2. Computer Buses, William Buchanan, CRC Press, 2000.
3. Data Communications & Networking, A. Behrouz Forouzan,3RD edition, Tata Mc Graw
4. Industrial Data Communications, Lawrence M. Thompson and Tim Shaw, Fifth Edition, ISA
   Press, 2015.


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**References Books:**

1. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Prentice Hall of India Pvt. Ltd., 5thEdition. 2011.
2. Wireless Communication: Principles and Practice, William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.
3. Bowden,R., "HART Application Guide", HART Communication Foundation, 1999

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| Third Year B. Tech Instrumentation Engineering<br>Industrial Internet of Things | | | |
|---|---|---|---|
| **Course Code:** | **INPCC603** | **Credit** | **3** |
| **Contact Hours:** | 3 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

**Pre-requisites:** Embedded System Design

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | Understand the fundamental concepts, architecture, and components of the Industrial Internet of Things (IIoT). |
| 2 | Analyze data processing, big data analytics, and machine learning applications in IIoT. |
| 3 | Examine IIoT security challenges, cybersecurity frameworks, and risk mitigation strategies. |
| 4 | Understand standards, regulations, and ethical considerations in industrial automation. |
| 5 | Explore real-world applications of IIoT |

| Course Outcomes: Students will be able to |
|---|
| Explain the fundamental principles, architecture, and components of IIoT. |
| Analyze sensor data and implement predictive maintenance solutions in IIoT. |
| Identify and mitigate security threats and challenges in IIoT systems. |
| Demonstrate knowledge of industrial standards, regulations, and compliance for IIoT deployment. |
| Develop and implement a functional IIoT solution using hardware, software, and cloud integration. |
| Explore and assess real-world IIoT applications in various industries. |

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| Topics covered: |
|---|
| **Unit I: Introduction to IIoT (6 hrs.)**<br>Definition, scope, and importance of IIoT, Differences between IoT and IIoT,I IoT architecture and key components, Applications in various industries (Manufacturing, Healthcare, Agriculture, Energy, etc.),Challenges and benefits of IIoT adoption. |
| **Unit II: IIoT Devices, Sensors, and Actuators (6 hrs.)**<br>Types of industrial sensors (temperature, pressure, vibration, etc.), Data acquisition and signal processing, Embedded systems and industrial controllers ,Actuators and control mechanisms in IIoT, Interfacing sensors with IIoT platforms. |
| **Unit III: IIoT Data Monitoring & Control (6 hrs.)**<br>IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology. |
| **Unit IV: IIoT Security & Privacy(6 hrs.)**<br>Security Challenges in IIoT Deployments, Cybersecurity Frameworks for IIoT, Secure Authentication and Access Control, Data Encryption and Secure Communication, Industrial Cyberattack Case Studies and Risk Mitigation. |
| **Unit V: IIoT Standards, Regulations & Compliance(6 hrs.)**<br>ISO and IEC Standards for IIoT, Industrial IoT Security Standards (NIST, ISA/IEC 62443), Regulatory Compliance (GDPR, HIPAA, NERC-CIP for Industrial Applications), Ethical Considerations in IIoT. |
| **Unit VI: IIoT Applications and Future Trends (6hrs.)**<br>Smart factories and Industry 4.0, IIoT in energy management and smart grids, Role of IIoT in supply chain and logistics, Plant Safety and Security (Including AR and VR safety applications), Digital transformation strategies, Emerging trends: Blockchain. |

**Text Books:**

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: A press
2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.
3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.
4. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers

**References Books:**

1. Sabina Jeschke, Christian Brecher Houbing Song , Danda B. Rawat Editors Industrial Internet of Things Cyber Manufacturing Systems
2. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821- 140-7, Willy Publications Olivier Hersent, David Boswarthick, Omar Elloumi,

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| Third Year B. Tech Instrumentation Engineering<br>Project Engineering and Management | | | |
|---|---|---|---|
| **Course Code:** | **INPCC604** | **Credit** | 3 |
| **Contact Hours:** | 3 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation40 Marks | End-sem. Examination60 Marks | |

**Pre-requisites: Knowledge of Organization Structure ,Types & Function.**

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To relate and apply the basic concept of Project organization and management for instrumentation projects |
| 2 | To learn and understand the project Initiation and Finance Management. |
| 3 | To Know the development stages of Project . |
| 4 | To learn and know the use of various standards in instrumentation Projects |
| 5 | To get the Knowledge of front end engineering design and testing Activity its documentation. |

| Course Outcomes: Students will be able to | |
|---|---|
| 604.1 | Evaluate the role and responsibilities in the project. |
| 604.2 | Identify the tools of project planning and budget . |
| 604.3 | Apply the design documents/ activities required in different phases of the project. |
| 604.4 | Classify the standards required for project development. |
| 604.5 | Interpret the design information from the documents. |
| 604.6 | Implement various construction and testing activities. |

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| Topics covered: |
|---|
| **Unit I: Project Management and Project Teams (06 hrs)**<br>A] Project Management:<br>Introduction and objectives of Project Management, Types of projects and related information. Project manager, purpose of project management. Project Organization Techniques -Matrix project organization, Project-Oriented project organization<br>B] Project Team:<br>Teamwork, teams for small project, working with multiple teams, design teams, team management, key factors in team leadership, motivating teams |
| **Unit II: Project Initiation and Finance Management (07hrs)**<br>Design & construction process, private v/s public projects, phases of a project, project strategy. Importance of early estimates, estimating work process, establishing an estimate work plan. Methods & Techniques of early estimate, estimate checklist & documentation, project budgets, design budgets. |
| **Unit III: Development stages of project (07hrs)**<br>Organizational structures, forming the project team, kick-off meeting, work packages, project execution plan, problems in developing project definition, design proposals, engineering project controls, techniques for planning and scheduling |
| **Unit IV Instrumentation Preliminary and FEED Project Engineering Documents and Standards (08hrs)**<br>Introduction to ISA standards: ISA S-5.1, 5.2, 5.3, 5.4, 5.5 and S-20, Preliminary Engineering Documents: PFD, P&ID (ISA S-5.1, 5.3), Process Control Narratives. Front End Engineering and Design (FEED) documents: Plant and piping layouts, Instrument schedule, I/O schedule, Instrument specification sheets (ISA S-20), logic diagram (ISA S-5.2), sizing and calculation documents, Instrument layout, Junction box layout, system Architecture and network layout diagrams, Control room layouts. |
| **Unit V : Detail Engineering Design ( 06hrs)**<br>Cable Engineering: Class of conductors, Types, Specification, Selection, Cable identification schemes, Cable trays. Earthing and Grounding for General and power Signals. Instrument Loop wiring diagrams (ISA S-5.4), Instrument Hook up, BOM and MBOM. Control room layout, Panel layout and General arrangement (GA) drawings. |
| **Unit VI: Project Close out and Testing Activities ( 07hrs)**<br>System testing & start-up, final inspection, guarantee of warranties.<br>Construction Activities – Installation & commissioning activities, documents required at this stage. Factory Acceptance Test (FAT), Customer Acceptance Test (CAT), Sites Inspection & Testing (SAT), Cold commissioning & hot commissioning. |

**Text Books:**


1. Management systems by John Bacon (ISA).
2. Project Management A System Approach to Planning, Scheduling and Controlling by Harold Kerzner (Van Nostrand Reinhold Publishing).
3. Applied instrumentation in process industries by Andrew & Williams (Gulf Publishing).


**References Books:**


1. Garold D. Oberlender, " Project Management for Engineering and Construction " Mc Grow Hill.
2. Instrument Installation Project Management (ISA).


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| Third Year B.Tech Instrumentation Engineering<br>Deep Learning | | | |
|---|---|---|---|
| **Course Code:** | **INPEC605A** | **Credit** | **03** |
| **Contact Hours:** | 03 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

**Pre-requisites:** Machine learning.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To explain basics of neural networks. |
| 2 | To describe different deep learning models. |
| 3 | To explain recurrent and recursive nets in deep learning |
| 4 | Introduction to reinforcement learning. |

| Course Outcomes: Students will be able to | |
|---|---|
| 605A.1 | Describe the basics of deep learning and its applications. |
| 605A.2 | Implement deep neural network. |
| 605A.3 | Apply the technique of Convolution Neural Network (CNN) for implementing deep learning models. |
| 605A.4 | Apply the technique of Recurrent Neural Network (RNN) for implementing deep learning models. |
| 605A.5 | To implement and apply deep generative models. |
| 605A.6 | To describe reinforcement learning process. |

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| Topics covered: |
|---|
| **Unit I: Introduction to Deep Learning (06)**<br>What is machine learning and deep learning? Limitations of machine learning, History of deep learning, Advantage and challenges of deep learning. Learning representations from data, Understanding how deep learning works in three figures, Common Architectural Principles of Deep Network, Applications of Deep learning, Introduction and use of popular industry tools such as TensorFLow, Keras, PyTorch, Caffe, Shogun. |
| **Unit II: Deep Neural Networks (DNNs) (06)**<br>Introduction to Neural Networks :The Biological Neuron, The Perceptron, Multilayer Feed-Forward Networks , Training Neural Networks :Back propagation and Forward propagation Activation Functions :Linear ,Sigmoid, Tannh, Hard Tanh, Softmax, Rectified Linear, Loss Functions :Loss Function Notation , Loss Functions for Regression , Loss Functions for Classification, Loss Functions for Reconstruction, Hyperparameters : Learning Rate, Regularization, Momentum, Sparsity, Deep Feedforward Networks – Example of Ex OR, Hidden Units, cost functions, error backpropagation, Gradient-Based Learning. |
| **Unit III: Convolution Neural Network (CNN) (06)**<br>Introduction, CNN architecture overview, The Basic Structure of a Convolutional Network-Padding, Strides, Typical Settings, the ReLU layer, Pooling, Fully Connected Layers, The Interleaving between Layers, Local Response Normalization, Training a Convolutional Network |
| **Unit IV: Recurrent Neural Network (RNN) (06)**<br>Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs. |
| **Unit V: Deep Generative Models (06)**<br>Introduction to deep generative model, Boltzmann Machine, Deep Belief Networks, Generative adversarial network (GAN), discriminator network, generator network, types of GAN, Applications of GAN networks |
| **Unit VI: Reinforcement Learning (06)**<br>Introduction of deep reinforcement learning, Markov Decision Process, basic framework of reinforcement learning, challenges of reinforcement learning, Dynamic programming algorithms for reinforcement learning, Q Learning and Deep Q-Networks, Deep Q recurrent networks. |

**Text Books:**

1. Goodfellow, I., Bengio, Y.,,Courville, A, "Deep Learning", MIT Press, 2016.
2. Josh Patterson & Adam Gibson, "Deep Learning"
3. Charu Agarwal, "Neural Networks and deep learning", A textbook
4. Nikhil Buduma, "Fundamentals of Deep Learning", SPD
5. Francois chollet, "Deep Learning with Python"

**References Books:**

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction"
2. by Seth Weidman, "Deep Learning from Scratch: Building with Python from First Principles"O'Reily
3. Francois Duval, "Deep Learning for Beginners, Practical Guide with Python and Tensorflow"

**E- Books / E- Learning References:**

http://csis.pace.edu/ctappert/cs855-18fall/DeepLearningPractitionersApproach.pdf

2. https://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf

**MOOC Courses Links:** https://www.my-mooc.com/en/categorie/deep-learning

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| Third Year B.Tech Instrumentation Engineering<br>Advance Embedded System Design | | | |
|---|---|---|---|
| **Course Code:** | **INPEC605B** | **Credit** | **03** |
| **Contact Hours:** | 3 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | In-sem. Evaluation40 Marks | End-sem. Examination60 Marks | |

**Pre-requisites:** Digital Electronics, Embedded System.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External / Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | To study the 32 bit Microcontroller. |
| 2 | To explain the registers and memory organization in ARM microcontrollers. |
| 3 | To write the program by using various ARM instruction sets. |
| 4 | To implement the project on 32 bit microcontroller. |

| Course Outcomes: Students will be able to | |
|---|---|
| 605B.1 | Infer the various instruction sets in ARM microcontroller. |
| 605B.2 | Design and implement an advanced embedded system based on an 16/32-bit microcontroller. |
| 605B.3 | Develop software and hardware for embedded systems using ARM microcontroller |
| 605B.4 | Realize microcontroller systems with ARM. |
| 605B.5 | Identify the functionality of development boards to implement ARM embedded |
| 605B.6 | Design and develop real time ARM embedded systems used in industry |

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| Topics covered: |
|---|
| **Unit I: Introduction to ARM Microcontroller (6 hrs.)**<br>Pipeline Characteristics, RISC and ARM design philosophy, ARM family, ARM Core &Architecture – Arithmetic Logic Unit, Booth multiplier, Barrel shifter, Control unit, register file, ARM Functional Diagram, ARM Instruction set, Instruction cycle timings and programming. |
| **Unit II: ARM-32-bit Microcontroller (6 hrs)**<br>Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence, ARM Instruction Set – Thumb Instruction Set. |
| **Unit III: ARM7 Microcontroller (6)**<br>ARM7 LPC2148 Microcontroller Architecture, Block Diagram, Features, Memory Mapping, serial communication interface – USB 2, full speed device, multiple UARTs, SPI, SSP to 12C. 32-bit timers,10 bit DAC,10 bit ADC, PWM channel, fast GPIO lines and level sensitive external interrupts pins. |
| **Unit IV: Peripheral interface for Arm Processor. (6 hrs)**<br>Interfacing of LED with LPC2148, Interfacing of four digit 7-segment common anode multiplexed LED display with LPC2148, Interfacing of 16x2 LCD display (8-bit) with LPC2148, Interfacing of stepper motor with LPC2148, Interfacing of DC motor using L298 with LPC2148, Interfacing of electromechanical relay with LPC2148, , LPC 2148 interfacing with On-Chip (Internal) ADC. |
| **Unit V: THUMB and ARM Programming (6 hrs)**<br>ARM and THUMB differences, Register usage in Thumb, ARM Thumb Interworking. Embedded C/C++, General Structure of ARM assembly module, Assembler directives. |
| **Unit VI: ARM Application development (6 hrs)**<br>IoT based project using PLC2148 and WiFi module. LPC2148 Home Automation and Smart Home systems using Bluetooth. Elevator Controller using LPC2148. |

1. **Text Books:**
2. Arm System-on-chip Architecture, 2nd Edition 2015, Steve B. Furber, Pearso.
3. Microcontroller (ARM) and Embedded Systems, Raghunandan G. H., Cengage Learning India Pvt. Ltd., 2020,
4. A Getting Started Guide for MDK Version 5, Keil

**References Books:**

1. Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach, Alexander G. Dean, ARM Education Media.
2. ARM Architecture Reference Manual, Second Edition, David Seal, Addison-Wesley.

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| Third Year B.Tech Instrumentation Engineering<br>Building Automation | | | |
|---|---|---|---|
| **Course Code:** | **INPEC605C** | **Credit** | **3** |
| **Contact Hours:** | 3 Hrs/week (L) | **Type of Course:** | Lecture |
| **Examinatio nScheme** | In-sem. Evaluation 40 Marks | End-sem. Examination 60 Marks | |

**Pre-requisites:** Basic knowledge of Sensor Transducer and control system Engineering

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | In-Sem. Evaluation | Internal | 40 |
| 2. | End Semester Examination | External | 60 |

| Course Objectives | |
|---|---|
| 1 | Articulate the purpose and operation of HVAC system components, the operation of HVAC systems. |
| 2 | Apply knowledge of thermal comfort conditions and its impact on human comfort, productivity, And health. |
| 3 | To make students aware about the construction, operation various features of sensors and transducers. |
| 4 | Evaluate importance of fire safety systems |
| 5 | Demonstrate the security & access control system |
| 6 | Develop and implement preventive maintenance practices and schedules for building automation systems. |

| Course Outcomes: Students will be able to | |
|---|---|
| 605C.1 | Define and articulate the fundamental concepts of Building Automation Systems (BAS), including its scope, historical development, and key components. |
| 605C.2 | Integrate HVAC systems effectively by applying control strategies and energy management techniques also apply principles of lighting control systems, incorporating daylight harvesting and occupancy sensing. |
| 605C.3 | Identify and define critical comfort parameters, including temperature, humidity, air flow, pressure, and air quality and recognize the significance of maintaining optimal comfort levels in indoor environments. |
| 605C.4 | Select appropriate AHU types based on established criteria and demonstrate an understanding of energy-efficient design principles. |
| 605C.5 | Evaluate and differentiate between centralized and decentralized access control systems.Demonstrate knowledge of various card technologies, including smartcards, proximity cards, and Mi fare cards. |
| 605C.6 | Evaluate case studies on energy optimization, identifying successful examples and associated challenges. |

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| Topics covered: |
|---|
| **Unit I: INTRODUCTION TO BUILDING AUTOMATION (6 hrs.)**<br>**1.1Overview of Building Automation Systems (BAS)**<br>Definition, scope, and importance, Historical development and evolution<br>**1.2 Introduction to Intelligent Buildings**<br>Definition and characteristics of intelligent buildings, Lifecycle phases of buildings: Design, construction, operation, and renovation<br>**1.3 Components of BAS**<br>Sensors, actuators, controllers, Communication protocols (BACnet, Modbus) |
| **Unit II: BUILDING SYSTEM INTEGRATION (6 hrs.)**<br>**2.1 Integration of HVAC Systems**<br>Heating, ventilation, and air conditioning control<br>Energy management strategies<br>**2.2 Lighting Control Systems**<br>Principles of lighting control<br>Daylight harvesting and occupancy sensing<br>**2.3 Security and Access Control**<br>Intrusion detection systems<br>Access control technologies |
| **Unit III: Comfort Parameters for (6 hrs.)**<br>Introduction to temperature, humidity, air flow, pressure, and air quality Importance of maintaining optimal comfort levels<br>**3.1 Humidity Parameters:** Definitions of humidity, specific humidity, relative humidity, dew point, and saturation point Importance of controlling humidity in indoor environments<br>**3.2 Psychrometric Principles** Dry bulb and wet bulb temperature concepts Working principle of a psychrometer for humidity measurement.<br>**3.3 Measurement of CO2 Levels** Significance of monitoring CO2 in indoor spaces Techniques for measuring and controlling CO2 levels<br>**3.3 Air Filtration and Other Techniques** Importance of air filtration for maintaining indoor air quality Overview of ozonisation and UV techniques for air purification |
| **Unit IV: HVAC Air Systems - Air Handling Unit (AHU) & Terminal Units (VAV) (6 hrs.)**<br>**4.1 Concept of AHU**<br>Definition and role in HVAC systems, Importance of air handling in maintaining indoor air quality, Components of AHU, Different Types of AHU.<br>**4.2Design Considerations**<br>Selection criteria for different types of AHU, Balancing outdoor and return air ratios, Energy-efficient design principles,<br>**4.3 Operation Modes in AHU.**<br>Cooling Mode (Principles of cooling in AHU Applications and challenges Heating Mode , Working of heating coils in AHU Applications and considerations |
| **Unit V: Building Security – Access Control (6 hrs.)**<br>**5.1 Basic Concepts of Access Control.**<br>Definition and Significance Understanding the role of access control in building security Benefits of implementing access control systems. Access Control System Architecture .Overview of system components and their interactions |

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Differentiating between centralized and decentralized systems Additional Devices (Two-man Rule, Time and Attendance, Guard Tour, Elevator Control), Secure and Non-Secure Concepts.

**5.2 Card Technology Overview**

Types of Cards (Smartcard, Proximity Card, MI fare Cards)
Characteristics and applications of smartcards.

**5.3 CCTV and Camera in Building**

Understanding the fundamental role of Closed-Circuit Television (CCTV) in building security, System Architecture of CCTV System, Types of Cameras (Fixed, PTZ, Analog, Digital)
Characteristics and applications of fixed and Pan-Tilt-Zoom (PTZ) cameras

**5.4 Video Management System (DVR, DVM, NVR)**

Differentiating between Digital Video Recorder (DVR), Digital Video Matrix (DVM), and Network Video Recorder (NVR)

**Unit VI: ENERGY MANAGEMENT AND OPTIMIZATION (6hrs.)**

**6.1 Energy Efficiency Strategies**

Demand response and load shedding
Renewable energy integration

**6.2 Building Performance Monitoring**

Monitoring and analyzing energy consumption
Implementing energy-saving measures

**6.3 Case Studies on Energy Optimization**

Successful examples of energy-efficient buildings
Challenges and opportunities in energy management

**6.4 Diagnostic Tools and Techniques**

Identifying and resolving common issues
Use of diagnostic equipment

**6.5 Preventive Maintenance Practices**

Developing maintenance schedules

**Text Books:**

5. HVAC Systems Design Handbook, Fifth Edition by Roger W. Haines
6. HVAC Fundamentals, volume 1 to 3 by James E. Brumbaugh
7. Basics of Air Conditioning by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)
8. Fire Alarm and Detection System: Quick Book by A. Bhatia.

**References**

4. All About AHU's by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
5. Chillers Basics by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)

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| Third Year B.Tech Instrumentation Engineering<br>Process Instrumentation | | | |
|---|---|---|---|
| **Course Code:** | **INVSE606** | **Credit:** | **3** |
| **Contact Hours:** | 1 Hr/week (L)<br>4 Hrs/week(P) | **Type of Course:** | Lecture/Practical |
| **Examination Scheme** | Term-work<br>50 Marks | Practical<br>50 Marks | |

**Pre-requisites:** Basics of process control

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Term Work | Internal | 50 |
| 2. | Practical | External | 50 |

| Course Objectives | |
|---|---|
| 1 | To demonstrate design procedure for control of Heat Exchanger, Boiler, Distillation column control, Dryer, Evaporator, Continuous and batch reactor. |
| 2 | To identify process variables, control variables and an appropriate manipulated variables for their control and disturbance variables. |
| 3 | To gain knowledge and analysis of unit processes and unit operations. |
| 4 | To provide students with knowledge about principle and design of controller for pumps and compressors. |
| 5 | Use of appropriate software tools (e.g. MATLAB, SCILAB etc. Control Toolbox & Simulink) for design of well-tuned control loops. |

| Course Outcomes: Students will be able to | |
|---|---|
| 606.1 | Discuss the basic operations of Heat Exchanger, Dryer, Evaporator, Boiler, Distillation column, Reactors, Pumps and Compressors and Determine the scaling equations for unit processes and operations. |
| 606.2 | Analysis and design of controller for safety and process monitoring and understand the need for scaling of instruments. |
| 606.3 | Design an appropriate regulatory and servo controller (Feedback, Cascade and Feed forward) for Heat Exchanger, Dryer, Evaporator, Distillation column and Reactor to achieve desired performance. |
| 606.4 | Design an appropriate regulatory and servo controller (Feedback, Cascade, Selective Split range, Anti-surge) for Boiler, Pumps and Compressors to achieve desired performance. |
| 606.5 | Design/Develop, tuning, implementation and simulation of appropriate servo and regulatory controller for a given process using MATLAB Simulink and Estimate the performance measures. (Rise time, Settling time, Overshoot, Integral errors) |

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**Topics covered:**

**Unit I: Instrumentation for heat exchangers and dryers (2 hrs.)**
Operation of heat exchanger, controlled and manipulated variables in heat exchanger control problem, instrumentation for feedback, feed-forward, cascade control strategies for heat exchanger, types and operation of dryers, controlled and manipulated variables in dryer control problem, instrumentation for feedback and feed-forward control of various types of dryers.

**Unit II: Instrumentation for evaporators (2 hrs.)**
Types and operation of evaporators, Controlled and manipulated variables in evaporator control problem, instrumentation for feedback, feed-forward, cascade control strategies for evaporators.

**Unit III: Instrumentation for distillation columns (2 hrs.)**
Operation of distillation column, manipulated and controlled variables in distillation column control, instrumentation for flow control of distillate, top and bottom composition control, reflux ratio control, pressure control schemes.

**Unit IV: Boiler Instrumentation (2 hrs.)**
Operation of boiler, manipulated and controlled variables in boiler control, safety interlocks and burner management system, instrumentation for boiler pressure controls, air to fuel ratio controls, boiler drum level controls, steam temperature control, optimization of boiler efficiency.

**Unit V: Pumps and Compressors Controls (2 hrs.)**
**Pumps:** Types, On-off level, flow and pressure Control, Multi-pump system control, Starting and Stopping of pumps.
**Compressors:** Types, On-off Controls, Surge phenomenon, anti-surge control, throttling and override control.

**Unit VI: Control Valves, Control Elements, Troubleshooting (2 hrs.)**
Terminology associated with valves and final control elements, Components of a control valve, Applications of control valve types/elements, Role of the final control element in the control loop, Control valve actuators/operation, Facility practices related to process technician troubleshooting. .

**List of Practical Assignments:**
Students are expected to perform experiments on above topics. (Using DCS, MATLAB, SCILAB etc. wherever required.)

1. Study of boiler controls (Using DCS*)
2. Study of distillation column controls (Using DCS*)
3. Study of pumps and compressor controls (Using DCS*)
4. Design and implementation of controller for heat exchanger.
5. Develop and Implement PLC program for safety interlocks of boiler
6. Design and implementation of controller for steam drum level control
7. Design and implementation of controller for surge vessel level control.
8. Design and implementation of controller for distillation column control
9. Develop cascade controller for evaporator/dryer
10. Design and implementation of controller for chemical reactor
11. Develop anti-surge control strategy for compressor controls
12. Develop feedback control strategy of pumps
13. MATLAB Simulation of Control Valve Components
14. MATLAB-Based Troubleshooting of Control Valves and Elements in Process Industries
15. Virtual Lab - Flow Through Pipes
16. Virtual Lab - Reaction kinetic studies in a batch reactor
17. Process Control Instrumentation – A case study on any plant.

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**Text Books:**

1. "Chemical Process Control", Stephanopoulos George, Prentice Hall of India.
2. "Boiler Control System", D. Lindsey, McGraw Hill Publishing Company.
3. Optimization of Industrial Unit Processes: Bela G. Liptak

**References Books:**

1. "Process Control, Instrument Engineering Hand book", B.G. Liptak, Chilton Book Company.
2. "Hand book of Process Instrumentation", Considine McGraw Hill Publishing company.1999.
3. Tuning of industrial control systems, ISA.
4. Control valve Handbook, ISA
5. Process Control Systems- F. G. Shinskey, TMH

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| Third Year B. Tech Instrumentation Engineering<br>Project Engineering and Management Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPCC607** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (P) | **Type of Course:** | Practical |
| **Examination Scheme** | Oral examination 25 Marks | | |

**Pre-requisites:**

- Basic knowledge of ISA Symbols, Phases Of Project .
-

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Oral | External | 25 |

| Course Objectives | |
|---|---|
| 1 | To Learn and understand the standards Symbol of ISA. |
| 2 | To know the work break down structure and Project schedule and cable scheduling |
| 3 | To prepare the Quotation, Comparative statements and Purchase orders. |
| 4 | TO Prepare the Documentation , Bill Of Material . |

| Course Outcomes: Students will be able to | |
|---|---|
| 607.1 | Understand the ISA Symbol and its use. |
| 607.2 | Identify the tools of project planning and budget and Project Scheduling . |
| 607.3 | Apply the design documents/ activities required in Comparative Statement, Purchase Orders . |
| 607.4 | Classify the standards required for project development and cable Scheduling. |
| 607.5 | Interpret the design information from the documents and Prepare the bill of material |

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**List of Experiments:**

Students are required to perform minimum 08 experiments from the given list.

1. Study of standards and symbols ( ISA )
2. Design and develop the project development Schedule – WBS.
3. Preparation of Inquiry, Quotation, Comparative Statement, Purchase Orders.
4. Development of Process and Instruments diagram of Typical Process.
5. Prepare the sample cable Schedule.
6. Prepare the Specification Sheet.
7. Prepare a loop wiring diagram.
8. Prepare the Bill of material and its documentation.
9. Prepare a Hook up drawings for installation of transmitters and control valve.
10. Prepare documents required for FAT of a control Panel.
11. Develop instrument index sheet for P & ID developed in experiment 4.

A) Virtual Lab 1- Project Investment

**Text Books:**

**1.** Management systems by John Bacon (ISA).
**2.** Project Management A System Approach to Planning, Scheduling and Controlling by Harold Kerzner (Van Nostrand Reinhold Publishing).
**3.** Applied instrumentation in process industries by Andrew & Williams (Gulf Publishing).

**References Books:**

1. Garold D. Oberlender, " Project Management for Engineering and Construction " Mc Grow Hill.
2. Instrument Installation Project Management (ISA)

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| Third Year B.Tech Instrumentation Engineering<br>Industrial Internet of Things Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPCC608** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (P) | **Type of Course:** | Practical |
| **Examination Scheme** | Practical<br>50 Marks | | |

**Pre-requisites:**

- Basic knowledge of Sensor , Embedded System Design

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Practical | External | 50 |

| Course Objectives | |
|---|---|
| 1 | Understand the fundamental concepts, architecture, and components of the Industrial Internet of Things (IIoT). |
| 2 | Analyze the real world problems solution using IIOT |

| Course Outcomes: Students will be able to | |
|---|---|
| 608.1 | Explain the fundamental principles, architecture, and components of IIoT. |
| 608.2 | Explore and assess real-world IIoT applications in various industries. |

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**List of Experiments:**

Students are expected to perform any 8 experiments.

1. Introduction to IIoT Platforms
   - Setup and configure an IIoT development environment (e.g., Node-RED, ThingSpeak, AWS IoT, or Azure IoT Hub).
   - Connect and visualize sensor data on an IIoT platform.
2. Working with Industrial Sensors & Data Acquisition
   - Interface industrial sensors (temperature, humidity, pressure, vibration) with Arduino/Raspberry Pi.
   - Acquire real-time data and display it on a dashboard.
3. IIoT Communication using MQTT Protocol
   - Implement MQTT communication between an edge device and a cloud server.
   - Publish and subscribe to sensor data topics.
4. Edge Computing in IIoT
   - Implement local data processing on an edge device.
   - Compare latency and efficiency of edge vs. cloud processing.
5. Industrial Actuator Control using IIoT
   - Control an industrial motor, relay, or valve using an IIoT platform.
   - Implement a remote ON/OFF mechanism via a web dashboard.
6. Cloud Integration for IIoT Data Storage
   - Send sensor data to AWS IoT, Google Cloud IoT, or Azure IoT.
   - Store and analyze historical sensor trends.
7. Predictive Maintenance using Machine Learning
   - Collect and preprocess vibration data from a motor.
   - Use machine learning (ML) to predict equipment failure.
8. Security in IIoT Networks
   - Implement TLS encryption in MQTT communication.
   - Simulate a cyberattack (DoS attack) on an IIoT network and apply mitigation techniques.
9. Digital Twin Implementation
   - Create a basic digital twin of a machine using Python & MATLAB.
   - Simulate machine behavior based on real-time sensor inputs.
10. Smart Factory Simulation using IIoT
    - Develop a small Industry 4.0 model with interconnected devices.
    - Monitor and control the factory using a SCADA-like dashboard.
11. IIoT-Based Energy Monitoring System
    - Implement real-time power consumption monitoring using a smart energy meter.
    - Generate energy efficiency reports on an IIoT dashboard.
12. Fleet Management & GPS Tracking with IIoT
    - Interface a GPS module to track industrial vehicle movement.
    - Send location data to an IIoT cloud platform.
13. Smart Agriculture using IIoT
    - Implement an IoT-based irrigation system.
    - Use soil moisture sensors to automate watering based on real
14. Introduction to NI myRIO for IIoT Applications
    - Overview of NI myRIO hardware and LabVIEW software.
    - Setting up Wi-Fi or Ethernet connectivity for IIoT.
    - Deploying a basic real-time data acquisition system using NI myRIO.
15. Sensor Integration and Data Acquisition
    - Interfacing temperature, pressure, vibration, and humidity sensors with NI myRIO.
    - Acquiring and displaying real-time data on LabVIEW.

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- Logging sensor data to a file for analysis.

16. IIoT Communication using MQTT with myRIO
    - Implementing MQTT protocol on NI myRIO for IIoT applications.
    - Publishing and subscribing sensor data to an MQTT broker (Mosquitto, HiveMQ).
    - Visualizing real-time sensor data on a web-based IoT dashboard.

**Text Books:**

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: A press
2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.
3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.
4. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers

**References**

1.Sabina Jeschke, Christian Brecher Houbing Song , Danda B. Rawat Editors Industrial Internet of Things Cyber Manufacturing Systems
2.Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1- 84821- 140-7, Willy Publications Olivier Hersent, David Boswarthick, Omar Elloumi,

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| Third Year B. Tech Instrumentation Engineering<br>Deep Learning Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPEC609A** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week<br>(P) | **Type of Course:** | Practical |
| **Examination Scheme** | Termwork<br>50 Marks | | |

**Pre-requisites:**

- Machine Learning.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Termwork | Internal | 50 |

| Course Objectives | |
|---|---|
| 1 | To explain the fundamental elements of deep learning for linear regression and classification. |
| 2 | To implement different deep learning models. |

| Course Outcomes: Students will be able to | |
|---|---|
| 609A.1 | Apply the technique of Deep Neural network for implementing Linear regression and classification. |
| 609A.2 | Apply the technique of Convolution (CNN) for implementing Deep Learning models. |
| 609A.3 | Design and develop Recurrent Neural Network (RNN) for prediction. |

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**List of Experiments:**

Students are required to perform all experiments from the given list.

1. Linear regression by using Deep Neural network: Implement Boston housing price prediction problem by linear regression using Deep Neural network. Use Boston House price prediction dataset.
2. Multiclass classification using Deep Neural Networks: Example: Use the OCR letter recognition. Dataset: https://archive.ics.uci.edu/ml/datasets/letter+recognition
3. Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset.
4. Use any dataset of plant disease and design a plant disease detection system using CNN.
5. Use MNIST Fashion Dataset and create a classifier to classify fashion clothing into categories.
6. Recurrent neural network (RNN): Use the Google stock prices dataset and design a time series analysis and prediction system using RNN.
7. Human Face Recognition using deep learning.
8. Gender and Age Detection: predict if a person is a male or female and also their age using deep learning techniques
9. Colorizing Old B&W Images: color old black and white images to colorful images using deep

**Text Books:**

1. Goodfellow, I., Bengio, Y.,,Courville, A, "Deep Learning", MIT Press, 2016.
2. Josh Patterson & Adam Gibson, "Deep Learning"
3. Charu Agarwal, "Neural Networks and deep learning", A textbook
4. Nikhil Buduma, "Fundamentals of Deep Learning", SPD
5. Francois chollet, "Deep Learning with Python"

**References Books:**

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction"
2. by Seth Weidman, "Deep Learning from Scratch: Building with Python from First Principles"O'Reily
3. Francois Duval, "Deep Learning for Beginners, Practical Guide with Python and Tensorflow"

**E- Books / E- Learning References:**

1. http://csis.pace.edu/ctappert/cs855-18fall/DeepLearningPractitionersApproach.pdf
2. https://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf

**MOOC Courses Links:** https://www.my-mooc.com/en/categorie/deep-learning

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| Third Year B.Tech Instrumentation Engineering<br>Advance Embedded System Design Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPEC609B** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (P) | **Type of Course:** | Practical |
| **Examination Scheme** | Practical<br>50 Marks | | |

**Pre-requisites:** Digital Electronics Embedded System.

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Termwork | Internal | 50 |

| Course Objectives | |
|---|---|
| 1 | To study the 32 bit Microcontroller. |
| 2 | To explain the registers and memory organization in ARM microcontrollers. |
| 3 | To write the program by using various ARM instruction sets. |
| 4 | To implement the project on 32 bit microcontroller. |

| Course Outcomes: Students will be able to | |
|---|---|
| 609B.1 | Infer the various instruction sets in ARM microcontroller. |
| 609B.2 | Design and implement an advanced embedded system based on an 16/32-bit microcontroller. |
| 609B.3 | Develop software and hardware for embedded systems using ARM microcontroller |
| 609B.4 | Realize microcontroller systems with ARM. |
| 609B.5 | Identify the functionality of development boards to implement ARM embedded |
| 609B.6 | Design and develop real time ARM embedded systems used in industry |

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**List of Experiments:**

Students are required to perform minimum 8 experiments from the given list.

1. Simple programs on Arithmetic & logical operations, Factorial, string operation, sorting using KEIL MKD for LPC2148
2. Write programs to turn ON/OFF LED using interrupt in ARM Assembly and ARM Embedded C. 3. Write programs to interface LCD in 4-bit mode in ARM Assembly and ARM Embedded C.
4. Write programs use of ADC in ARM Assembly and ARM Embedded C.
5. Write programs to interface LCD in 4-bit mode in ARM Assembly and ARM Embedded C.
6. Write programs to generate various waveforms (square, triangular, sawtooth) using DAC in ARM Assembly and ARM Embedded C.
7. Write programs to interface stepper motor and rotate in clockwise and anticlockwise in ARM Assembly and ARM Embedded C.
8. Write programs to interface Bluetooth with LPC21048.
9. Write programs to interface USB with LPC21048
10. Write program to display Day, Month and Year using RTC of LPC2148 on LCD

Students are required to perform minimum 2 experiments on Virtual Lab

**Text Books:**

1. Arm System-on-chip Architecture, 2nd Edition 2015, Steve B. Furber, Pearso.
2. Microcontroller (ARM) and Embedded Systems, Raghunandan G. H., Cengage Learning India Pvt. Ltd., 2020,
3. A Getting Started Guide for MDK Version 5, Keil

**References Books:**

1. Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach, Alexander G. Dean, ARM Education Media.
2. ARM Architecture Reference Manual, Second Edition, David Seal, Addison-Wesley.

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| Third Year B.Tech Instrumentation Engineering<br>Building Automation Lab | | | |
|---|---|---|---|
| **Course Code:** | **INPEC609C** | **Credit** | **1** |
| **Contact Hours:** | 2 Hrs/week (L) | **Type of Course:** | Practical |
| **Examination Scheme** | Termwork<br>Examination<br>50 marks | | |

**Pre-requisites:**

- Basic knowledge of Sensor Transducer and control system Engineering

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Termwork | Internal | 50 |

| Course Objectives | |
|---|---|
| 1 | Articulate the purpose and operation of HVAC system components, the operation of HVAC systems. |
| 2 | Apply knowledge of thermal comfort conditions and its impact on human comfort,<br>productivity, And health. |
| 3 | To make students aware about the construction, operation various features of sensors and transducers. |
| 4 | Evaluate importance of fire safety systems |
| 5 | Develop and implement preventive maintenance practices and schedules for building automation systems. |

| Course Outcomes: Students will be able to | |
|---|---|
| 609C.1 | Define and articulate the fundamental concepts of Building Automation Systems (BAS), including its scope, historical development, and key components. |
| 609C.2 | Integrate HVAC systems effectively by applying control strategies and energy management techniques also apply principles of lighting control systems, incorporating daylight harvesting and occupancy sensing. |
| 609C.3 | Identify and define critical comfort parameters, including temperature, humidity, air flow, pressure, and air quality and recognize the significance of maintaining optimal comfort levels in indoor environments. |
| 609C.4 | Select appropriate AHU types based on established criteria and demonstrate an understanding of energy-efficient design principles. |
| 609C.5 | Evaluate and differentiate between centralized and decentralized access control systems.<br>Demonstrate knowledge of various card technologies, including smartcards, proximity cards, and Mi fare cards. |
| 609C.6 | Evaluate case studies on energy optimization, identifying successful examples and associated challenges. |

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**Topics covered:**

List of Experiments :

Students are expected to perform Minimum 8 Experiments :

1. To study Architecture of BMS & IBMS
2. To study Psychometric chart and various parameters
3. To study different types of Air Handling Units
4. To study various terminal unit systems (CAV, VAV)
5. To study Chilled Water System and loops
6. To study Hot Water System and loops
7. To study FAS loops and classifications
8. To study SLC wiring, loops, classifications
9. To study cause and effect matrix-Fire alarm system
10. To study CCTV System Architecture and types of cameras
11. Design an alarm annunciator for level control system
12. Design an alarm annunciator for a temperature control system

**Text Books:**

1. HVAC Systems Design Handbook, Fifth Edition by Roger W. Haines
2. HVAC Fundamentals, volume 1 to 3 by James E. Brumbaugh
3. Basics of Air Conditioning by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0004 for online shopping)
4. Fire Alarm and Detection System: Quick Book by A. Bhatia.

**Reference Books:**

1. All About AHU's by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2. Chillers Basics by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)

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| Third Year B.Tech Instrumentation Engineering<br>Mini Project | | | | |
|---|---|---|---|---|
| Course Code | INELC610 | Credit | 1 | |
| Contact hours | 02 Hrs/week | Type of course | Practical | |
| Examination scheme | Term work<br>25 marks | | | |

**Fundamental practical Knowledge of:**

1. Basic Electronics
2. Electrical Engineering
3. Linear Integrated Circuits
4. Digital Techniques
5. Embedded Systems

**Course Assessment methods/tools:**

| Sr. No. | Course Assessment methods/tools | External/Internal | Marks |
|---|---|---|---|
| 1 | Term work | Internal | 25 |

| Course Objectives | |
|---|---|
| 1 | To undertake & execute a Mini Project through a group of students |
| 2 | To understand the "Product Development Cycle", through Mini Project. |
| 3 | To learn budget planning for the project. |
| 4 | To understand the importance of document design by compiling Technical Report on the Mini Project work carried out. |

| Course Outcomes: Students will be able to | |
|---|---|
| 610.1 | Planning and implementation of hardware/ software project |
| 610.2 | Prepare the budget for hardware requirement . |
| 610.3 | Demonstrate the project . |
| 610.4 | Work as a team member. |

**Maximum Group size:**

Minimum 1 and maximum 2 students can form a group for the mini project.

**Project Type:**

It is mandatory to develop prototype hardware system/product along with software, if any.

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**A] Project development stages:**

| Sr. No. | Project development stages/steps |
|---|---|
| 1 | Topic finalization. |
| 2 | Literatures review minimum 10 latest papers. (Elsevier, Springer, IEEE, UGC care etc.) |
| 3 | Preparation of specifications of proposed system and tentative block diagram |
| 4 | Preparation of Bill of materials. |
| 5 | Design of circuits/selection of components, Procurement of components and stage wise implementation and testing on bread board. (Study of data sheets) |
| | Software development, if any. |
| 6 | Preparation of PCB of the finalized circuit and mounting of components on PCB and its soldering. |
| 7 | Testing of circuit on PCB. |
| 8 | Design and fabrication of suitable enclosure and outside fittings such as switches, buttons, knobs, meters, indicators, displays etc. |
| 9 | Report writing |
| 10 | Participation and paper publication/intellectual property rights. |

**B] Project Report Preparation:**

| Chapter | | Description | Page Nos. |
|---|---|---|---|
| | | Cover page | |
| | | Certificate | |
| | | Acknowledgement | |
| | | Abstract | |
| | | Tables (Figures, Abbreviations, etc.) | |
| 1 | | Introduction of project | |
| 2 | | Problem statement, objectives of project, Proposed specifications | |
| 3 | | Product development stages | |
| 4 | | Literature survey | |
| 5 | | Block diagram explanation | |
| 6<br>6.1<br><br><br>6.2 | <br><br>6.1.1<br>6.1.2<br><br>6.2.1<br>6.2.2 | Hardware design<br>Primary sensing element<br>- Selection of components<br>- Calculations<br>Signal conditioning circuits<br>- First stage<br>- Second stage | |
| 7 | | Software design. (Flowchart, Algorithms etc.) | |
| 8 | | PCB artwork | |
| 9 | | Testing procedures | |
| 10 | | Test results | |
| 11 | | Enclosure design | |
| 12 | | Conclusion | |
| | | Bill of material | |
| Annex.-I | | Published paper/certificates. | |
| Annex.-II | | Any special data sheet | |

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**Note 1:** Above points in A and B are just guidelines, it may change as per the project type/guide suggestions.

**Guidelines for report preparation:**

| | |
|---|---|
| 1 | 1 Printing: A4 size bond paper for report. |
| 2 | Spacing between two lines should be 1.5. |
| 3 | Margins: Left- 1.25", Right- 1", Top and bottom- 0.75" |
| 4 | Font style: Times New Roman |
| 5 | Font sizes: Title of the chapter-18, sections- 16, subsections- 14, and the text- 12. |
| 6 | All figures, equations and tables must be numbered. |
| 7 | Binding: Spiral (Front spiral binding page glossy finish |

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| Third Year B.Tech Instrumentation Engineering<br>FOREIGN LANGUAGE LEVEL-II GERMAN | | | |
|---|---|---|---|
| **Course Code:** | **IOHSM6ACA** | **Credit:** | **01** |
| **Contact Hours:** | 1 Hr./Week (L) | **Type of Course:** | Lecture |
| **Examination Scheme** | Term Work<br>25 Marks | | |

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Term Work | Internal | 25 |

| Course Objectives | |
|---|---|
| 1 | To get introduced to the Culture, Routine of the German Society through language. |
| 2 | To meet the needs of ever growing German industry with respect to language support. |

| Course Outcomes: Students will be able to | |
|---|---|
| 6ACA.1 | Develop reading, writing and listening skills. |
| 6ACA.2 | Use tenses in German Language. |
| 6ACA.3 | A Develop interest to pursue a German language course. |
| 6ACA.4 | Get an comprehensive understanding of basic German Language and build a good enough vocabulary to articulate themselves in any given daily life situation. |

**Topics covered:**

**Unit I: Introduction of Cases (06 hrs)**
Introduction of Cases: Nominative, Akkusative, Personal & Possessive Pronouns in Nominative, Akkusative

**Unit II: Prepositions and Tenses (06 hrs)**
Prepositions:- Akkusative
Tenses:- Past tense of sein & haben Verbs . Simple sentences and questions using vocabulary
Formal and informal conversations .

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**Text Books:**

1. "Netzwerk A-1 (Deutsch als Fremdsprache) " Goyal Publishers & Distributors Pvt. Ltd

**Reference Books:**

1. Tipps und Uebungen A1

**Online Resources:**

1. Practice Material like online Worksheets regarding the Grammar.
2. Nptel Course On German -Ii Language
3. Online German-English Dictionary www.Leo.Org

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| Third Year B.Tech Instrumentation Engineering<br>Foreign Language Japanese Level II | | | |
|---|---|---|---|
| **Course Code:** | IOHSM6ACB | **Credit** | 1 |
| **Contact Hours:** | 01Hr/Week | **Type of Course:** | Lecture |
| **Examination scheme:** | Term-work<br>25 marks | | |

**Course assessment methods/tools:**

| Sr. No. | Course assessment methods/tools | External/ Internal | Marks |
|---|---|---|---|
| 1. | Term Work | Internal | 25 |

| Course Objectives | |
|---|---|
| 1 | To understand the basics of the Japanese writing system, including Kanji characters. |
| 2 | To indicate an action or motion in progress, describe habitual actions, and express permission and prohibition. |

| Course Outcomes: Students will be able to | |
|---|---|
| 6ACB.1 | Demonstrate basic communication skills. |
| 6ACB.2 | Describe their daily routines in Japanese. |
| 6ACB.3 | Describe things, people, and places using appropriate adjectives. |
| 6ACB.4 | Express the existence or presence of a thing or a person in different contexts. |

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| Topics covered: |
|---|
| **UNIT I: Kanji Basics (6 hrs.)**<br>Introduction to Kanji Script, Describing one's daily routine. To ask what someone does. Expressions of Giving & Receiving.<br>Adjectives (Types of adjectives) Asking for an impression or an opinion about a thing / person / place that the listener has experienced, visited, or met, Describing things / person / places with the help of the adjectives.<br>Expressions of Like & Dislikes. Expressing one 's ability. Talking about one's hobbies. Comparison between objects, persons & cities. Audio Learning |
| **UNIT II: Spatial, Action and Progressive Basics (6 hrs.)**<br>Stating existence or a presence of thing (s), person (s) Relative positions,<br>Introduction to counters - Part II<br>Expressing one 's Desire & wants, Verb groups, Asking, instructing a person to do something.<br>Indicating an action or motion is in progress. Describing habitual action Describing a certain continuing state which resulted from a certain action in the past. Express permission & prohibition. Audio Learning |

**Text Books:**

1. Minna No Nihongo, "Japanese for Everyone", Elementary Main Textbook 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd

**Reference Books:**

1. George Trombley, Yukari Takenaka "Japanese from Zero!" Learn From Zero Publisher

**MOOC/NPTEL courses**

1. NPTEL Course on "**JapaniBhasha –SaralSwaroop (Japanese course taught in Hindi)** "
Link of the Course: https://onlinecourses.nptel.ac.in/noc23_hs76/preview
2.NPTEL Course on " Introduction to Japanese Language and Culture"
Link of the Course :https://onlinecourses.nptel.ac.in/noc19_hs52/preview

**Guidelines for Assessment (Any one of following but not limited to)**

- Written Test
- Presentation
- Report

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| Third Year B.Tech Instrumentation Engineering<br>Lifelong Learning Skill-III | | | |
|---|---|---|---|
| **Course Code:** | **IOLLC6L3** | **Credit:** | **1** |
| **Examination Scheme** | Term-work<br>25 Marks | | |

Lifelong Learning Skills courses introduced for holistic development of students where all the students are required to acquire 1 credit in 6th semester from **Extracurricular Activities** or **co-curricular Activities** which will have grades as below. Activity Certificate obtained either in 5th or 6thsem from below mentioned activities will be considered for grading in 6th sem.

**1) Extracurricular Activities:**

| Sr. No. | Activity | Level | Achievement | Grade | Achievement | Grade |
|---|---|---|---|---|---|---|
| 1. | Sports | Inter collegiate | Participation | P | Prize winner | C |
| | | University | Participation | C | Prize winner | B |
| | | Zonal | Participation | B | Prize winner | B+ |
| | | State | Participation | B+ | Prize winner | A |
| | | National | Participation | A | Prize winner | A+ |
| | | International | Participation | A+ | Prize winner | O |
| 2. | NSS/NCC | Camp | Attended | B | | |
| | | Camp + 5 Activities | Attended | B+ | | |
| | | Camp + 10 Activities | Attended | A | | |
| | | Camp + 15 Activities | Attended | A+ | | |
| | | Camp + 20 Activities | Attended | O | | |
| 3. | Cultural | Inter collegiate | Participation | B | Prize winner | B+ |
| | | State | Participation | B+ | Prize winner | A |
| | | National | Participation | A | Prize winner | A+ |
| | | International | Participation | A+ | Prize winner | O |
| 4. | Community Engagement | Certified by NGO/Authorities with report and geo-tagged photograph | 1 Activity | B | | |
| | | | 2 Activities | B+ | | |
| | | | 3 Activities | A | | |
| | | | 4 Activities | A+ | | |
| | | | 5 Activities | O | | |

**OR**

**2) Co-curricular Activities:**

| Sr. No. | Activity | Level | Achievement | Grade | Achievement | Grade |
|---|---|---|---|---|---|---|
| 1. | Conference | National | Participation | B | Prizewinner | A |
| | | International | Participation | B+ | Prizewinner | A+ |
| | | International (Scopus indexing) | Participation | A+ | Prizewinner | O |
| 2. | Journal Publication | Non-refereed but recognized and reputed journal/periodical having ISSN number. | | B | | |
| | | Refereed Journal - As listed by UGC | | A | | |
| | | Refereed Journals- As listed by Scopus | | A+ | | |

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| | | | | | | |
|---|---|---|---|---|---|---|
| | | Refereed Journals - As listed by SCI/SCIE | | O | | |
| 3. | Hackathon | AICTE SIH | Participation | A | Prizewinner | O |
| | | National | Participation | B+ | | |
| | | State | Participation | B | | |
| | | Zonal | Participation | P | | |
| 4. | Professional Body | National | Membership | P | 3rd Prize | A |
| | | | Activities participation | B | 2nd Prize | A+ |
| | | | 5 participations | B+ | 1st Prize | O |
| 5. | Internship | 1 week | Completed | C | | |
| | | 2 week | Completed | B | | |
| | | 3 week | Completed | B+ | Sponsored Project | A+ |
| | | 4 week | Completed | A | Job through internship | O |
| 6. | Entrepreneurs hip | Awareness camp | Attended | A | Product Developed | A+ |
| | | | | | Own Startup | O |
| 7. | Project/Technic al events | Inter collegiate | Participation | P | Prizewinner | C |
| | | University | Participation | C | Prizewinner | B |
| | | Zonal | Participation | B | Prizewinner | B+ |
| | | State | Participation | B+ | Prizewinner | A |
| | | National | Participation | A | Prizewinner | A+ |
| | | International | Participation | A+ | Prizewinner | O |

The marks with respect to grades are as follows:

| Sr. No. | Grade | Marks |
|---|---|---|
| 1 | O | 25 |
| 2 | A+ | 22 |
| 3 | A | 20 |
| 4 | B+ | 18 |
| 5 | B | 16 |
| 6 | C | 13 |
| 7 | P | 10 |
| 8 | F | 0-5 |

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| Third Year B.Tech Instrumentation Engineering<br>Lifelong Learning Skill -IV | | | |
|---|---|---|---|
| **Course Code:** | **IOLLC6L4** | **Credit:** | **1** |
| **Examination Scheme** | **ISE 10** | **ESE 10** | **TW 5** |

**Under IOLLC6L4 Campus to Corporate Readiness Program (CCRP) will be considered and evaluated.**

- CCRP training will be conducted by an external agency for 2 hours per week during Semester IV and VI.
- The external agency will conduct the in-semester exam independently, as well as the end-semester exam.
- Evaluation rubrics for the end-semester exam will be provided by the external agency at the start of the training.

- **+ This term work marks are based on attendance of the student for CCRP sessions.**

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