KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)

S.P.G.Chidambara Nadar - C.Nagammal Campus

S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

Regulation - 2020

AUTONOMOUS SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

VII TO VIII SEMESTER CURRICULUM AND SYLLABI

VISION:

To develop competent Electronics and Instrumentation Engineers with Societal, Environmental and Human Values through Quality Education, Training and Research.

MISSION:

Department of Electronics and Instrumentation Engineering is committed to

1. Impart technical knowledge and skills to meet the industry needs.
2. Build self-learning capability among the students to update the recent technology.
3. Tie up with the industries and research institution.
4. Create passion for serving the society with moral and ethical values.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the programme will be able to

PEO 1: Work in the Design, Automation, Testing and Software Industries.

PEO 2: Pursue higher studies and research in the field of Process Control, Biomedical, Robotics & Automation and Renewable Energy Resources.

PEO 3: Be an Entrepreneur by building leadership quality and teamwork

PROGRAM OUTCOMES:

After going through the four years of study, the Electronics and Instrumentation Engineering graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Design and develop mathematical model for transducer, process control system.

PSO2 : Select and use appropriate hardware circuit and software tools to control industrial and automation process.

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	GE1771	Principles of Management	FC	3	3	0	0	3
2	GE1471	Professional Ethics and Human Values	FC	3	3	0	0	3
3	EI1701	Logic and Distributed Control System	PC	3	3	0	0	3
4	PE5	Professional Elective –V	PE	3	3	0	0	3
5	PE6	Professional Elective -VI	PE	3	3	0	0	3
6	OE2	Open Elective –II*	OE	3	3	0	0	3
PRACTICALS								
7	EI1711	Industrial Automation Laboratory	PC	4	0	0	4	2
8	EI1721	Mini Project	EEC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**08**	**22**

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	EI1821	Project Work	EEC	16	0	0	16	8
			TOTAL	**16**	**0**	**0**	**16**	**8**

*** Course from the Curriculum of other UG Programmes.**

PROFESSIONAL ELECTIVES (PEs)

PROFESSIONAL ELECTIVE V (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1731	Image Processing	PE	3	3	0	0	3
2.	EI1732	Instrumentation and Control for Power Plant	PE	3	3	0	0	3
3.	EI1733	Navigation and Guidance System	PE	3	3	0	0	3
4.	EI1734	Wireless Sensor Network	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE VI (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1735	Automotive Instrumentation	PE	3	3	0	0	3
2.	EI1736	Medical Imaging Systems	PE	3	3	0	0	3
3.	EI1737	Nuclear Instrumentation	PE	3	3	0	0	3
4.	EI1738	Robotics and Automation	PE	3	3	0	0	3

OPEN ELECTIVE – II (SEMESTER VII)
OFFERED BY DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

S.No.	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Offered to MECH, ECE & MTRE								
1.	OEI171	Introduction to Industrial Measurements	OE	3	3	0	0	3
Offered to ECE, EEE, MECH & MTRE								
2.	OEI172	Mechanical Measurements	OE	3	3	0	0	3
Offered to CSE, ECE,EEE & MECH								
3.	OEI173	PLC and SCADA	OE	3	3	0	0	3

GE1771 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give a basic idea about the need of management principles in all kinds of organization.
- To understand the managerial functions like planning, organizing, staffing, directing and controlling.
- To gain some knowledge about different structures of organization.
- To understand the role played by leader in different levels, and to understand the qualities, skills required for the leader while leading a team globally.
- To gain some knowledge about international management.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Nature, Scope and Functions of Management – Evolution of Management – Contributions of FW Taylor (14 principles of Management), Henri Fayol, Elton Mayo, Roethilisberger, H.A.Simon and P.F Drucker- Management theories - Science or Art – Manager Vs Entrepreneur- types of managersmanagerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches –Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority –Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Directing meaning-importance-principles of directing - Motivation – Motivation theories –

Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership– Communication – Process of communication, types of communication and its uses – Barrier in communication – Effective Communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Inventory Management – PERT, CPM – Application - Control and performance – Direct and preventive control.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to

CO1 Explain the trends and challenges of management in global scenario, the different types of organization and its effectiveness.

CO2 Utilize the strategies and policies which are involved in planning, Steps involved in the process of planning and use it for decision.

CO3 Identify the structure, purpose, selection and recruitment process in organizations.

CO4 Explain the various motivational theories and processes of management including its functions

CO5 Compare and contrast the various control techniques.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich., 2010. *Essentials of Management*, Tata McGraw Hill.
2. Stephen P. Robbins and Mary Coulter., 2009. *Management*, Prentice Hall (India)Pvt. Ltd., 10th Edition.

REFERENCE BOOKS:

1. Robert Kreitner and Mamata Mohapatra., 2008. *Management*, Biztantra.
2. Stephen A. Robbins, David A. Decenzo and Mary Coulter., 2011. *Fundamentals of Management*, Pearson Education, 7th Edition.
3. Tripathy P.C. and Reddy P.N., 2010. *Principles of Management*, Tata McGraw Hill.

GE1471 PROFESSIONAL ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values.
- To impart Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation –Commitment – Empathy – Self-confidence – Character – Spirituality – Stress management Techniques.

UNIT II ENGINEERING ETHICS 9

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas –Moral Autonomy – Kohlberg‘s theory – Gilligan‘s theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest –Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development –Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors –Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Summarize the various Morals, Values, Ethics, Integrity and other Human Values.

CO2 Describe the Senses of Engineering ethics, its related Theories and Models of Professional Roles.

CO3 Explain the Codes of Ethics for various Engineering Experiments.

CO4 Examine the various Risk, Safety and Risk Benefit Analysis for a Product/Service in an Organization.

CO5 Explain the Various Global Issues in Ethics and Review the Responsibilities and Rights of Professionals and Employees in an Organization.

REFERENCE BOOKS:

1. Mike W. Martin and Roland Schinzinger, 2017. *Ethics in Engineering*, 4th Edition, McGraw Hill.
2. Govindarajan M, Natarajan S, and Senthil Kumar V. S, 2004. *Engineering Ethics*, Prentice Hall of India.
3. Charles B. Fleddermann., 2012. *Engineering Ethics*, 4th Edition, Prentice Hall.
4. Charles E. Harris, Michael S. Pritchard, Raw W. James, Elaine E. Englehardt, and Michael J. Rabins, 2019. *Engineering Ethics – Concepts and Cases*, 12th Edition, Cengage Learning.
5. John R Boatright, and Jeffery Smith, 2016. *Ethics and the Conduct of Business*, 8th Edition, Pearson Education.
6. Edmund G Seebauer and Robert L Barry, 2001. *Fundamentals of Ethics for Scientists and Engineers*, South Asia Edition, Oxford University Press.

EI1701 LOGIC & DISTRIBUTED CONTROL SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the importance of process automation techniques.
- To impart knowledge in PLC based programming.
- To introduce distributed control system and different communication protocols.

UNIT I INTRODUCTION 9

Review of PC based control design for process automation: Functional Block diagram of Computer control of process - Mathematical representation – Sampling Consideration- Data Acquisition system and SCADA, Hybrid, Direct Digital Control System, Distributed Control system architecture and Comparison with respect to different performance attributes.

UNIT II APPLICATIONS OF PLC 9

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, Block diagram of PLC. General PLC programming procedures: ON/OFF instruction, Timer instruction sets, Counter Instruction sets -Design, development and simulation of PLC programming using above instruction sets for simple applications.

UNIT III PLC INSTRUCTIONS 9

PLC Data manipulation instruction - Arithmetic and comparison instruction- Skip, Master Control Reset (MCR) and Zone Control Last state (ZCL) instruction – PID and other important instruction set. PLC Installation, troubleshooting and maintenance. Design of alarm and interlocks, networking of PLC – Case studies using above instruction sets.

UNIT IV DCS AND INTERFACING 9

Distributed Control system: Local Control Unit (LCU) architecture - Comparison of different LCU architectures – LCU Process Interfacing Issues: - Block diagram, Overview of different LCU security design approaches, secure control output design, Manual and redundant backup designs.

UNIT V COMMUNICATION FACILITIES 9

LCU communication Facilities - Communication system requirements – Architectural

Issues – Operator Interfaces – Engineering Interfaces. Development of Field Control Unit (FCU) diagram for simple control applications. Introduction to HART and Field bus protocol. Interfacing Smart field devices (wired and wireless) with DCS controller. Introduction to Object Linking and Embedding (OLE) for Process Control, Automation in the cloud with case studies.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to

CO1 To familiar with process automation technologies.

CO2 To design and develop a PLC ladder programming for simple process applications.

CO3 To understand the various PLC instruction sets.

CO4 To apply different security design approaches, engineering and operator interface issues for designing of Distributed control system.

CO5 To familiar with latest communication technologies like HART and Field bus protocol.

TEXT BOOKS:

1. John W. Webb and Ronald A Reis, 2003. *Programmable Logic Controllers - Principles and Applications,* Prentice Hall Inc., New Jersey, 5th Edition.
2. Lukcas M.P., 2016. *Distributed Control Systems,* Van Nostrand Reinhold Co., New York.
3. Frank D. Petruzella., 2016. *Programmable Logic Controllers,* McGraw Hill, New York, 5th Edition.

REFERENCE BOOKS:

1. Deshpande P.B and Ash R.H, 2000. *Elements of Process Control Applications,* ISA Press, New York.
2. Curtis D. Johnson., 2013. *Process Control Instrumentation Technology,* Pearson New International, 8th Edition.
3. Krishna Kant., 2011. *Computer-based Industrial Control,* Prentice Hall, New Delhi, 2nd Edition.

EI1711 INDUSTRIAL AUTOMATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

To impart practical skills in

- To identify the difference between various PLC's.
- To provide the skills to install and trouble shoot PLC systems.
- To provide working experience in various programming Techniques.
- To interface various field devices with PLC.
- To construct program for SCADA applications.

LIST OF EXPERIMENTS:

1. Study of different PLC's and their Specification (AI, AO, DI, DO modules)
2. Study of installations and troubleshooting of PLC
3. Programming Logic Gates Function in PLC
4. Implementing Mathematical Operations in PLC
5. Programming Jump-to-subroutine & return operations in PLC
6. PLC Exercises: - 1. Traffic Light Control and Filling/Draining Control Operation
7. PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
8. PLC based control of Level Process
9. Develop one application using SCADA System
10. AC motor speed control using PLC and VFD
11. Study of Foundation Fieldbus /IOT/Wireless HART Enabled Transmitter

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to

CO1 Able to carry out wiring connections and troubleshoot in different PLC's.

CO2 Ability to understand and Programming the PLC & SCADA.

CO3 Use timers and counter function of PLC to construct simple applications.

CO4 Integrate and control process station with PLC.

CO5 Develop SCADA application using open source software.

CO6 Perform speed control on AC motor using VFD & PLC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Hardware :

1) PLC Panel board with power supply. – 6 No's
    a. Siemens (SIMANTIC S7 200) PLC
    b. Allen Bradley (Micro Logix 1200) PLC
    c. Delta (DVP – SS Series) PLC
2) Process Control Station
3) ½ HP AC motor
4) VFD to control ½ HP AC motor
5) Traffic Light Controller – 2 N0's
6) DC Motor – 2 No's
7) Personal Computer – 10No's
8) Smart Transmitter – 1 No.

Software :

1) Siemens/ Allen Bradley/ Delta PLC Software
2) Open Source SCADA software such as Free SCADA, Open SCADA, Idigo SCADA CodeSys open source for PLC Programming and interfacing with real time PLC.

EI1721 **MINI PROJECT**

L	T	P	C
0	0	4	2

OBJECTIVES:

- To develop their own innovative prototype of ideas.
- To train the students in preparing mini project reports and examination.

The student in a group of 5 to 6 works on a topic approved by the head of the department and prepares a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 On Completion of the mini project work students will be in a position to take up their final year project work and find solution by formulating proper methodology.

EI1821 **PROJECT WORK**

L	T	P	C
0	0	16	8

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination

The student in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 240 PERIODS

OUTCOMES:

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

CO1 On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

EI1731 **IMAGE PROCESSING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the formation of an image and its acquisition.
- To introduce the application of transforms in image processing.
- To study techniques for improving quality of information in images.
- To get familiarized with image and video processing techniques.
- To apply image and video processing in industrial applications.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Elements of digital image processing systems – Digital Image Representation - Elements of visual perception – Image acquisition - Image sampling and Quantization – Image geometry – Discrete Image Transforms- Properties- Color image fundamentals:- RGB, HSI models.

UNIT II IMAGE PREPROCESSING AND ENHANCEMENT 9

Point processing methods: Contrast stretching – Gray level slicing- Histograms, Histogram equalization and specification techniques, Spatial filtering, Directional Smoothing, Median, Geometric mean, and Harmonic mean filters - Color image enhancement.

UNIT III IMAGE SEGMENTATION AND ANALYSIS 9

Detection of Discontinuities, Edge linking, Boundary detection, Thresholding – Region oriented segmentation-Watershed segmentation – Object detection - Pattern Recognition – Classification

UNIT IV DIGITAL VIDEO PROCESSING 9

Video acquisition - Inter-frame processing, Motion Estimation and Compensation – Filtering – Video segmentation – Tracking by detection – Tracking multiple objects.

UNITV APPLICATIONS OF IMAGE AND VIDEO PROCESSING 9

Applications in measurements, manufacturing, medicine, agriculture and food industry – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 Ability to understand the technical terms associated with image and video processing.

CO2 Ability to select the appropriate preprocessing techniques for manipulation of images.

CO3 Ability to utilize the different approaches of image enhancement, segmentation and analysis techniques.

CO4 Ability to apply different digital video processing methods.

CO5 Ability to design automated techniques for image based applications.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 2004, *Digital Image Processing* Pearson, Education Inc., Second Edition.
2. Anil K. Jain, 2002, *Fundamentals of Digital Image Processing*, Pearson Education, Inc.
3. Thomas. B. Moeslund, 2012, *Introduction to Video and Image Processing*, Springer.

REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 2004, Steven Eddins, *Digital Image Processing using MATLAB* Pearson Education, Inc.
2. John W. Woods, 2011 *Multidimensional Signal, Image and Video Processing*, Elsevier, 2nd Edition.
3. William K. Pratt, 2005 *Digital Image Processing*, John Wiley, New York.
4. Alan C. Bovik, *Handbook of image and video processing* Elsevier Academic press.
5. Murat Tekalp,A., 2015 *Digital Video Processing*, Prentice Hall, 2nd Edition

EI1732	INSTRUMENTATION AND CONTROL FOR POWER PLANT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to various power generation methods.
- To impart knowledge on various processes/systems involved in thermal power generation.
- To provide the knowledge on specific measurement techniques and control systems practiced in boiler and turbine units.
- To impart basic knowledge in nuclear power plant and associated instrumentation.

UNIT I BRIEF SURVEY OF METHODS OF POWER GENERATION 9

Hydro, thermal, nuclear, solar and wind power – Introduction to thermal power plant processes – building blocks - ideal steam cycles – Boilers – types – sub-critical and super critical, Boiler - turbine units and its range systems, feed water systems, steam circuits, combustion process, products of combustion process, fuel systems, treatment of flue gases, steam turbine, condensate systems, alternator, feed water conditioning, turbine bypass valves. Importance of instrumentation in power generation – details of boiler processes, major P & I diagram for a boiler – combined cycle power plant, power generation and distribution.

UNIT II MEASUREMENT IN BOILER AND TURBINE 9

Metal temperature measurement in boilers, impulse piping system for pressure measuring devices, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity measurement. Installation of non-contracting transducers for speed measurement, rotor and casing movement and expansion measurement.

UNIT III CONTROLS IN FURNACE 9

Problems associated with control of multiple pulverizers. Draught plant: Introduction, natural draught, forced draught, induced draught, balanced draught, power requirements for draught systems. Fan drives and control, control of air flow. Combustion control: Fuel/Air ratio, oxygen, CO and CO2 trimming, combustion efficiency, excess air, parallel and cross limited combustion control, control of large systems.

UNIT IV CONTROLS IN BOILER 9

Boiler drum level measurement methods, feed water control, soot-blowing operation, steam temperature control, Coordinated control, boiler following mode operation, turbine following mode operation, constant / sliding pressure operation, selection between boiler and turbine following modes. Distributed control system in power plants-interlocks in boiler operation. Turbine control: Shell temperature control-steam pressure control – lubricant oil temperature control – cooling system.

UNIT V NUCLEAR POWER PLANT INSTRUMENTATION 9

Piping and instrumentation diagram of different types of nuclear power plant, Nuclear reactor control loops, reactor dynamics, excess reactivity, pulse channel and logarithmic instrumentation, control and safety instrumentation, reliability aspects

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 To explain various types of boilers and power generation methods.

CO2 To identify suitable measurement system for boilers and turbines.

CO3 To design Combustion control and draught plant control circuits.

CO4 To understand various controls in boiler and need for DCS.

CO5 To demonstrate P& ID of nuclear power plant and its safety reliability aspects.

TEXT BOOKS:

1. Philip Kiameh., 2014, *Power Plant Instrumentation and Controls,* McGraw-Hill Professional.

2. SwapanBasu. and Ajay Debnath., 2014, *Power Plant Instrumentation and Control Handboo*k, 1st Edition, Academic Press.

3. David Lindsley., 2000, *Power-plant Control and Instrumentation: The Control of Boilers and HRSG Systems*, IET, London.

REFERENCE BOOKS:

1. Krishnaswamy, K.,.andPonnibala, M., 2011, *Power Plant Instrumentation*, PHI Learning Pvt.Ltd., New Delhi.

2. Elonka, S.M..andKohal, A.L, 1994, *Standard Boiler Operations*, McGraw-Hill, New Delhi.
3. Gilman, G. F. and Jerry Gilman, 2010, *Boiler Control Systems Engineering,* ISA.
4. Gill A.B., 1984, *Power Plant Performance*, Butterworth, London.

EI1733 NAVIGATION & GUIDANCE SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

- Acquire basic knowledge about Aircraft and Aerospace Instrumentation
- Gain knowledge about Navigation and Guidance Systems
- To study about Satellite and space Instrumentation.
- Get adequate knowledge about radio navigation aids, aircraft flight simulation instrumentation.
- To study about electrical troubles and its applications.

UNIT I AIRCRAFT & AEROSPACE VEHICLE INSTRUMENTATION 9

Air data instruments: altimeter, air speed rate of climb-gyroscopic instruments – turn and back indicator – artificial horizon-directional Gyro Schuler Tuning, stable platform-automatic pilots-integrated flight instruments – magnetic composers.

UNIT II RADIO NAVIGATION AIDS 9

Automatic direction finder – instrument landing system – visual Omni range – distance measuring equipments – radar – optical instruments engine instruments and control – pressure measurements – thermal meters control – pressure measurements – thermal meters – smoke and fire detection – propeller controls

UNIT III SATELLITE & SPACE INSTRUMENTATION 9

Satellite and space vehicle instrumentation – propulsion controls – stabilization – stabilization sensors – gyros – sun sensors horizon scanner – star tracker – stabilization controls.

UNIT IV AIR CRAFT FLIGHT SIMULATION INSTRUMENTATION 9

Basic description of a flight simulator - solutions of aerodynamics equations – simulation of abnormal conditions. Jet engine power plant troubles - fuel system troubles – flight controls and auto pilot troubles

UNIT V ELECTRICAL TROUBLES 9

Hydraulic systems troubles – landing gear troubles – cabin conditioning troubles, indication

of unsafe canopy being conditions – radio troubles – separate generator – system troubles – trouble indicator lights – other functions – advantages of instrumented flight – simulation.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 To state the basic concepts of Aircraft and Aerospace Instrumentation.

CO2 To explain the Navigation and Guidance Systems.

CO3 To discuss about the satellite and space instrumentation.

CO4 To evaluate the radio navigation aids, air craft flight simulation instrumentation.

CO5 To develop the electrical troubles and its applications.

TEXT BOOKS:

1. Daniel J.Biezad,1999 *Integrated Navigation and Guidance Systems,* American Institute of Aeronautics and Astronautics; Har/Dsk edition
2. Douglas M. Considine and S.D. Ross, 2003 *Handbook of Applied Instrumentation* – McGraw Hill.

REFERENCE BOOKS:

1. David Wyatt,2014 *Aircraft flight Instruments and Guidance Systems, CRC Press.*
2. Ching-Fang Lin, 2017. *Modern Navigation, Guidance, And Control Processing* Prentice Hall Series.

EI1734 **WIRELESS SENSOR NETWORKS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of wireless communication & Networks.
- To enable the knowledge about adhoc/sensor network design issues and applications
- To study the various protocols at MAC layer and its differences with traditional protocols.
- To know about the various types of routing protocols.
- To recognize the issues pertaining to sensor networks and the challenges involved in managing a sensor network.

UNIT I FUNDAMENTALS OF WIRELESS COMMUNICATION 9

Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

UNIT II INTRODUCTION TO ADHOC/SENSOR NETWORKS 9

Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

UNIT III MAC PROTOCOLS 9

MAC Protocols : Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC,IEEE 802.15.4.

UNIT IV ROUTING PROTOCOLS 9

Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

UNIT V QoS AND ENERGY MANAGEMENT 9

Quality of Service (QoS) and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy

management, classification, battery, transmission power, andsystem power management schemes.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Understand the fundamental concepts and characteristics of wireless communication and sensor networks.

CO2 Illustrate the architecture of adhoc/sensor networks and to understand the challenges and issues in adhoc wireless sensor networks.

CO3 Interpret the significance of MAC protocols and to understand the challenges and issues in designing a MAC protocol.

CO4 Understand the types, design and working of routing protocol.

CO5 Summarize the importance of QoS and Energy management and describe various issues and challenges in QoS.

TEXT BOOKS:

1. Siva Ram Murthy, C and Manoj B.S., 2008. *AdHoc Wireless networks*, Pearson Education.

REFERENCE BOOKS:

1. Feng Zhao and Leonides Guibas, 2004. *Wireless sensor networks*, Elsevier publication.
2. Jochen Schiller, 2003. *Mobile Communications*, Pearson Education, 2nd Edition.
3. William Stallings, 2004. *Wireless Communications and Networks*, Pearson Education.

EI1735 AUTOMOTIVE INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on automobile system, its subsystems and components.
- To expose the students to the concepts of various sensors used in automobile systems.
- To teach the basic and advanced controls in automotive systems.
- To impart knowledge about the electronics and software involved in automotive systems.

UNIT I INTRODUCTION OF AUTOMOBILE SYSTEM 9

Current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.

UNIT II ENGINE MANAGEMENT SYSTEMS 9

Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, Fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control

UNIT III VEHICLE POWER TRAIN AND MOTION CONTROL 9

Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.

UNIT IV ACTIVE AND PASSIVE SAFETY SYSTEM 9

Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags.

UNIT V AUTOMOTIVE STANDARDS AND PROTOCOLS 9

Automotive standards like CAN protocol, LIN protocol, FLEX RAY, Head-Up Display (HUD), OBDII, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262). System design and energy management: BMS (battery management system), FCM (fuel control module), principles of system design, assembly process of automotive and instrumentation systems.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to

CO1 Identify the automotive system and its components.

CO2 Attain knowledge of various sensors and conditioning circuit used in automotive systems.

CO3 Gain knowledge about various control strategies used in automotive application

CO4 Understand the knowledge of safety system in automotive systems

CO5 Gain knowledge about the electronics and software used in automotive application

TEXT BOOKS:

1. William B. Ribbens, 2012. *Understanding Automotive Electronics*, Butterworth-Heinemann publications, 7th Edition.

REFERENCE BOOKS:

1. Young A.P., Griffiths L., 2010. *Automotive Electrical Equipment*, ELBS & New Press.
2. Tom Weather Jr.,& Cland C. Hunter, 2009. *Automotive computers and control system*, Prentice Hall Inc., New Jersey.
3. Crouse W.H., 2005. *Automobile Electrical Equipment*, McGraw Hill Co. Inc., New York.
4. Bechtold, 2010. *Understanding Automotive Electronic*, SAE.
5. BOSCH, 2014. *Automotive Hand Book*, Bentely Publishers, Germany, 9th Edition.

EI1736 **Medical Imaging System**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To make students familiarized with various medical imaging modalities.
- To impart knowledge on new developments in diagnostic methods for different imaging techniques

UNIT I INTRODUCTION TO X-RAY 9

Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, Fluoroscopy, Angiography, Mammography and Xeroradiography, Biological effects of ionizing radiation.

UNIT II COMPUTED TOMOGRAPHY 8

Conventional tomography, Computed tomography – Projection function, Algorithms for image reconstruction, CT number, Image artifacts, Spiral CT. Recent developments – Digital radiography, Digital subtraction angiography (DSA), 3D reconstruction, Dynamic spatial reconstructor (DSR), Single photo emission computer tomography – Positron emission tomography.

UNIT III ULTRASOUND IMAGING 10

Fundamentals of acoustic propagation - Characteristic impedance, Intensity, Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Transducer beam characteristics-Huygens's principle, Axial and Lateral resolution, Focusing, Arrays, Pulse echo systems- Amplitude mode (A-mode), Brightness mode(B-mode), Motion mode (M-mode), Constant depth mode (C-mode), Doppler methods, Duplex imaging, Tissue characterization, Color Doppler Flow Imaging, Ultrasound Contrast Media, Intracavity Imaging, 2-D echo cardiography.

UNIT IV MRI SYSTEM & IMAGING METHODS 9

Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Rotating frame of reference and RF magnetic field, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences. Instrumentation in MRI Imaging, Spin-Echo imaging, Gradient echo imaging- Biological effects of magnetic fields.

UNIT V RADIONUCLIDE IMAGING AND THERMAL IMAGING 9

Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclide, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic methods using radiation detector probes – Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems, Medical thermography, Instrumentation in thermography, Endoscopy.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Select appropriate medical imaging systems for diagnosis and therapeutic applications.

CO2 Understand fundamentals of imaging based on radiation.

CO3 Comprehend the knowledge of all the components of various imaging modalities.

CO4 Apply the different techniques for image reconstruction.

CO5 Understand the purpose of medical imaging, advancement in Medical imaging techniques and diagnostic methods and its biological effect for various imaging modalities.

TEXT BOOKS:

1. Kirk Shung, Michael B. Smith and Banjamin Tsui, *Principles of Medical Imaging*, Academic Press, 2012.
2. R.S.Khandpur, *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 3rd Edition, 2019.

3. Paul Suetens, “Fundamentals of Medical Imaging” Cambridge University Press, 3rd Edition, 2017.

REFERENCE BOOKS:

1. Jerry L.Prince and Jonathan M. Links, *Medical Imaging Signals and Systems*, Pearson Education Inc., 2nd Edition, 2015.
2. John G. Webster, *Medical Instrumentation Application and Design*, John Wiley and sons, 4th Edition New York, 2015.
3. Andrew Webb, *Introduction to biomedical imaging*, IEEE press series, Wiley Interscience, 2017

EI1737 **NUCLEAR INSTRUMENTATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the basic concepts of radioactivity.
- To gain broad range of working knowledge of radiation detectors.
- To encompasses the principles of operation of various types of radiation monitors, analyzers.
- To understand the beneficial effects of radiation in medicine.
- To appreciate various types of reactors and personal monitors in industry .

UNIT I RADIOACTIVITY 9

General Properties of Nucleus, Radioactivity, Nature of Nuclear Radiations, Characteristic properties of radioactive radiations, Properties of Alpha, Beta, and Gamma rays, Natural and artificial radio-activity. Radioactivity Laws, Half-life period, radioactive series, Isotopes and Isobars, fission and fusion, chain reaction, Various effects- photoelectric, Compton scattering and pair production, stopping power and range of charged nuclear particles.

UNIT II RADIATION DETECTORS 9

Techniques for weak signal detection, Detectors for Alpha, beta and gamma rays, Detector classification. Ionization chamber, Regions of multiplicative operation, Proportional counter, Geiger Muller counter-volt ampere characteristics, Designing features, Scintillation detectors (Photomultiplier tube- types, dark currents, scintillators, pulse resolving power), efficiency detection, SNR improvement, Solid state detectors (Lithium ion drifted -Si-Li, Ge-Li, Diffused junction, surface barrier)

UNIT III ELECTRONICS AND COUNTING SYSTEMS 9

Pre-amplifier, main amplifiers, Discriminators, Scalars and count rate meters, Pulse shaping, pulse stretchers, Coincidence circuits, photon counting system block diagram, factors influencing resolution of gamma energy spectrum, Energy resolution in radiation detectors, single and multichannel analyzers (MCA), Pulse height analyzers (PHA).

UNIT IV APPLICATION IN MEDICINES 9

Gamma camera- design, block diagram, medical usage. Radiation uptake studies- block

diagram and design features. Nuclear Instrumentation for health care, Radiation Personnel Health Monitors like neutron monitors, Gamma Monitors, Tritium monitors, Iodine monitors and PARA (Particulate Activity Radiation Alarms).

UNIT V APPLICATIONS IN INDUSTRY 9

Various types of reactor-BWR, PWR, PHWR, FBR, Basic Nuclear Instrumentation system-block diagram, Nuclear Instrumentation for laboratory. Personal monitors like Thermo Luminescence Detectors (TLD), Dosimeters, Tele-detectors, which are used to assess the radiation exposure to the radiation plant workers. Nuclear Instrumentation for power reactor, Nuclear Instrumentation for Toxic fluid tank level measurement, Underground Piping Leak detection, weighing, thickness gauges, water content measurement etc. Agriculture applications like food irradiation

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 To explain various measurements in the field of nuclear technology.

CO2 Discuss about the application of nuclear instrumentation in industry.

CO3 To classify the various radiation detectors.

CO4 Describe the application of nuclear technology in medicine.

CO5 To State the principle and working of various reactors, monitors and analyzers.

TEXT BOOKS:

1. Knoll, G.F., 2010 *Radiation Detection & Measurement,* John Wiley & Sons, 4th Edition.
2. Nicholson,P.W., 1974 *Nuclear Electronics,* John Wiley.
3. Kapoor, S.S., & Ramamurthy, V.S., 2011 *Nuclear Radiation Detectors,* New Age International, 2nd Edition.

REFERENCE BOOKS:

1. Gaur & Gupta, 2001.*Engineering Physics, DanpatRai& Sons.*
2. Theraja, Irvin Kaplan, 1987. *Nuclear Physics, Narosa,* Addison Wesley Publication, 2nd Edition
3. Avdhamulu, M.N.,& Kshirsagar, P.G., 2008.*Engineering Physics, S.Chand & Co.*

EI1738 **ROBOTICS & AUTOMATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on the basic concepts associated with the design, functioning, applications and social aspects of robots.
- To provide the concept of electrical drive systems and sensors used in robotics for various applications.
- To make the students learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector.
- To educate about various motion planning techniques and the associated control architecture.
- To make the students explore the implications of AI and other trending concepts of robotics.

UNIT I FOUNDATION FOR BEGINNERS 9

Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator

UNIT II BUILDING BLOCKS OF ROBOT 9

Types of electric motors – DC Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self-driving cars.

UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS 9

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector -

common types and design case study

UNIT IV NAVIGATION, PATH PLANNING & CONTROL ARCHITECTURE 9

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot.

UNIT V AI & OTHER RESEARCH TRENDS IN ROBOTS 9

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nano robots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 To explain the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation.

CO2 To examine different sensors and actuators for applications like maze solving and self-driving cars.

CO3 To analyzing robot kinematics, dynamics through different methodologies.

CO4 Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning.

CO5 Describe the impact and progress in AI and other research trends in the field of robotics.

TEXT BOOKS:

1. Saeed. B. Niku, 2011., *Introduction to Robotics, Analysis, system, Applications*, Pearson educations.
2. Roland Siegwart, & Illah Reza Nourbakhsh, 2011. *Introduction to Autonomous Mobile Robots*, MIT Press.

REFERENCE BOOKS:

1. Richard David Klafter, Thomas A. Chmielewski, & Michael Negin, 1989. *Robotic*

engineering: an integrated approach, Prentice Hall.

2. Craig, J. J.,1989. *Introduction to Robotics: Mechanics and Control*, Addison-Wesley, 2nd Edition.
3. Fu,K.C., Gonzalez,R.C., and Lee, C.S.G.,1987. *Robotics: Control, Sensing, Vision and Intelligence*, McGraw-Hill.
4. Wesley ,E & Snyder R,1988. *Industrial Robots, Computer Interfacing and Control*, Prentice Hall International Edition.
5. Robin Murphy, 2000. *Introduction to AI Robotics*, MIT Press.

OEI171 INTRODUCTION TO INDUSTRIAL MEASUREMENTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To make the students familiar with the specifications of transducers
- To expose the students to the importance of process variable measurements.
- To expose the students to various measurement techniques used for the measurement of temperature, flow, pressure and level in process industries.
- To make the students knowledgeable in the design, installation and trouble shooting of process instruments.

UNIT I INTRODUCTION AND TYPES OF TRANSDUCERS 9

Function of each block of Instrumentation system – Transducer: Need, classification - Electrical Transducers: Resistive transducers – Linear and Angular potentiometers, strain gauge, types, gauge factor - Capacitive transducer – Inductive transducer: LVDT, RVDT – Piezoelectric transducer - Photoelectric transducer: LDR, Photovoltaic cell

UNIT II PRESSURE MEASUREMENT 9

Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules – Electrical methods: Elastic elements with LVDT and strain Gauges - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, Ionization gauges, Cold cathode type and hot cathode type, Transmitter definition types, I/P and P/I Converters

UNIT III TEMPERATURE MEASUREMENT 9

Introduction to temperature measurements – Bimetallic Thermometers - Thermocouples, Resistance Temperature Detector, Thermistor and its measuring circuits - Radiation pyrometers - Thermal imaging.

UNIT IV FLOW MEASUREMENT 9

Introduction, definition and units - classification of flow meters - Differential Pressure and variable area flow meters - Positive displacement flow meters - Electro Magnetic flow meters - Hot wire anemometer - ultrasonic flow meters – Solid flow measurement.

UNIT V LEVEL MEASUREMENT 9

Level measurement: Float gauges - Displacer type – D/P methods -Bubbler System-Load

cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement:– Differential pressure method and Hydrostatic method - Solid level measurement.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to

CO1 Identify a transducer for a specific measurement application.

CO2 Understand the working of instruments used for measurement of pressure in process industries.

CO3 Understand the working of instruments used for measurement of temperature in process industries.

CO4 Understand the working of instruments used for measurement of flow in process industries.

CO5 Understand the working of instruments used for measurement of level in process industries.

TEXT BOOKS:

1. Ernest.O.Doebelin & Dhanesh.N.Manik, 2011. *Doebelin's Measurement Systems*, McGraw Hill Education, 6th Edition.
2. Liptak, B.G.., 2003. *Process Measurement and Analysis*, CRC Press, 4th Edition.
3. Patranabis D., 2010. *Principles of Industrial Instrumentation*, Tata McGraw Hill, 3rd Edition.

REFERENCE BOOKS:

1. Noltingk, B.E., 1995. *Instrumentation Reference Book*, Butterworth Heinemann, 2nd Edition.
2. Douglas M. Considine., 1999 *Process / Industrial Instruments & Controls Handbook*, McGraw Hill, Singapore, 5th Edition.
3. Andrew W.G., 2001. *Applied Instrumentation in Process Industries – A survey*, Vol. I & Vol. II, Gulf Publishing Company, Houston.
4. Spitzer D. W., 2005. *Industrial Flow measurement*, ISA press, 3rd Edition.
5. Tony. R. Kuphaldt., 2014. *Lessons in Industrial Instrumentation,* Version 2.02.

OEI172 MECHANICAL MEASUREMENTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the error and uncertainty in the measurement system using statistical analysis.
- To provide knowledge about various types of measuring methods

UNIT I INTRODUCTION TO MECHANICAL MEASUREMENTS 9

Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying inputs. Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. Errors in measurement: Types of errors, Effect of component errors, Probable errors.

UNIT II MEASUREMENT OF DISPLACEMENT AND SPEED 9

Displacement Measurement: Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder), Nozzle Flapper Transducer -Measurement of Speed: Tachometers, Tacho generators, Digital tachometers and Stroboscopic Method.

UNIT III MEASUREMENT OF STRAIN AND ACCELERATION 9

Strain Measurement: Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors -Acceleration Measurement: theory of accelerometer and vibrometers, practical accelerometers, strain gauge based and piezoelectric accelerometers

UNIT IV MEASUREMENT OF PRESSURE AND FLOW 9

Pressure Measurement: Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements, Bridge man gauge. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges- Flow Measurement: Bernoulli flow meter, Ultrasonic flow

meter, Magnetic flow meter, rotameter

UNIT V MEASUREMENT OF FORCE,TORQUE,VIBRATION AND NOISE **9**

Force measurement on Proving Ring, Load Cells: Hydraulic and Pneumatic, Torque Measurement on Rotating Shafts Dynamometers: Absorption, Transmission and Driving. Vibration and Noise measurement -Seismic Instruments, Vibration pick ups and decibel meters

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Classify various types of static characteristics and types of errors occurring in the system.

CO2 Select proper measuring instrument for linear and angular displacement.

CO3 Understand the construction and working of measuring instruments for strain and acceleration.

CO4 Interpret the principle of operation and characteristics of various methods for pressure and flow measurements.

CO5 Identify the suitable method for measuring force, torque, vibration and noise.

TEXT BOOKS:

1. Doebelin. E.O, 2011, *Measurement Systems: Applications and Design*, Tata McGraw Hill, 6th Edition.
2. Sawhney. A.K & Puneet Sawhney, 2017, *A Course in Mechanical Measurements and Instrumentation & Control*, Dhanpat Rai& Co, New Delhi.

REFERENCE BOOKS:

1. Raghavendra.N.V., & Krishnamurthy.L,2013, Engineering Metrology and Measurements, Oxford University Press.
2. Backwith, Marangoni & Lienhard, 2007, *Mechanical Measurements*, Pearson Education, 6th Edition.
3. Venkateshan. S.P, 2015, *Mechanical Measurements*, Wiley publication,2nd Edition.

OEI173 **PLC AND SCADA**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the fundamentals of Automation.
- To know the concept of PLC and its Programming using Ladder Diagram.
- To study the basics of HMI and Installations in PLC.
- To know the fundamental concepts of SCADA Systems

UNIT I PLC HARDWARE 9

Definition of Automation, Types and applications in Industry, Basic concepts of PLC, PLC components – I/O configuration, Introduction to PLC operation, Binary data representation, Input and Output status files, sixteen point I/O modules, PLC memory, Architecture of PLC:- Modular and brick type. I/O Modules: D/I, D/O, A/I, A/O and communication modules. PLC symbols, Advantages and Disadvantages of PLC, List PLC applications.

UNIT II BASICS OF PLC PROGRAMMING 9

Fundamentals of logic, PLC programming languages. Ladder diagrams, Ladder Diagram Instruction, Logic functions, Latching, Multiple outputs. Timer and counter- types along with timing diagrams shift registers, sequencer function, latch instruction; Arithmetic and logical instruction with various examples. ON/OFF switching devices, I/O analog devices, Analog PLC operation

UNIT III PLC INTERFACE TO VARIOUS CIRCUITS 9

Encoders, transducer and advanced sensors. Measurement of temperature, flow, pressure, force, displacement, speed, level. Developing ladder logic for Sequencing of motors, Tank level control, ON-OFF temperature control, elevator, bottle filling plant, car parking etc. Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

UNIT IV SCADA 9

Introduction, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures

(First generation - Monolithic, second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution). Open systems interconnection (OSI) Model, Process Field bus (Profibus). Interfacing of SCADA with PLC.

UNIT V HMI IN AUTOMATION 9

Basics of HMI, Applications of HMI, Developing graphics: -Temperature and Two Level control. Comparison of HMI with SCADA. Human Interface subsystem:-Operator panel, construction of Panel, Interfacing with control subsystem, types of mimic panels.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 To apply PLC architecture knowledge to select PLC for specific problems.

CO2 To use PLC Ladder diagram for simple applications.

CO3 To design real time application using PLC.

CO4 To discuss the configuration of SCADA functionalities with Tags, Screens, and Trends.

CO5 To create prototype for the real time application Using PLC with HMI.

TEXT BOOKS:

1. Gary Dunning, 2005, *Introduction to Programmable Logic Controllers*, Thomson, 2nd Edition.
2. John R. Hackworth, Frederick D., & Hackworth Jr., 2003, *Programmable Logic Controllers Programming Methods and Applications*, PHI Publishers.
3. John W. Webb, & Ronald A. Reis, 2003, *Programmable Logic Controllers: Principles and Application*, PHI Learning, New Delhi, 5th Edition.
4. Stuart A Boyer, 2009, *SCADA supervisory control and data acquisition*, ISA, 4th Revised edition.
5. Bryan L.A. & Bryan E. A., 1997, *Programmable Controllers Theory and Implementation*, Industrial Text Company Publication, Second Edition.

REFERENCE BOOKS:

1. Gordon Clarke, & Deon Reynders, 2004, *Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems*, Newnes An imprint of Elsevier Publications, 1st Edition.
2. Batten G. L., 1998, *Programmable Controllers*, McGraw Hill Inc., Second Edition.
3. Gordan Clark, & Deem Reynders, 2004, *Practical Modern SCADA Protocols*, ELSEVIER.