K.L.N. COLLEGE OF ENGINEERING

Pottapalayam – 630 612, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd*:* 1994

FINAL YEAR CURRICULUM AND SYLLABUS

REGULATIONS 2020

For Under Graduate Program

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

(For the students admitted from the academic year 2020-2021 onwards)

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

To impart Value and need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry.

VISION OF THE DEPARTMENT

To foster the graduates with excellence in innovation and research by imparting quality education in Electronics & Instrumentation Engineering and its allied areas.

MISSION OF THE DEPARTMENT

To produce competent professionals with social concern and ethical standards to cater the needs of Process automation industries and its associated fields.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 To design, analyze, develop and realize complex Electronics and Instrumentation Engineering problems.

PEO 2 To apply the emerging technologies in instrumentation and allied fields

PEO 3 To work effectively as an individual and as a member of multidisciplinary team.

PEO 4 To exhibit professionalism and ethical values in an eco-friendly manner.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1 Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronic circuits, process control and instrumentation field.

PSO 2 Apply appropriate techniques and modern Engineering hardware and software tools to design, implement & evaluate the control, measurement, process and instrumentation system to engage in life- long learning and work effectively as an individual and in a multidisciplinary team.

PSO 3 Understand the impact of Professional behavior and ethics, communicate effectively with engineering community and the society.

PO1: Engineering Knowledge

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

PO2: Problem Analysis

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

PO3: Design/Development of Solutions

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

PO4: Conduct Investigations of Complex Problems

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

PO5: Modern Tool Usage

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

PO6: The Engineer and Society

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

PO7: Environment and Sustainability

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

PO8: Ethics

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

PO9: Individual and Team Work

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

PO10: Communication

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

PO11: Project Management and Finance

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

PO12: Life-Long Learning

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

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REGULATIONS 2020

For Under Graduate Program

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS) Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory Courses (MC)** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

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Department of Electronics and Instrumentation Engineering

SEMESTER VII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20EI701	PLC and DCS	PC	3	3	0	0	3
2.	20EI702	Instrumentation system Design	PC	3	3	0	0	3
3.	----------	Open Elective II	OE	3	3	0	0	3
4.	---------	Professional Elective III	PE	3	3	0	0	3
5.	---------	Professional Elective IV	PE	3	3	0	0	3
PRACTICAL								
6.	20EI7L1	Industrial Automation Laboratory	PC	3	0	0	3	1.5
7.	20EI7L2	Instrumentation system Design Laboratory	PC	3	0	0	3	1.5
			TOTAL	21	15	0	6	18

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective V	PE	3	3	0	0	3
2.		Professional Elective VI	PE	3	3	0	0	3
PRACTICAL								
3.	20EI8L1	Project Work	EEC	20	0	0	20	10
			TOTAL	26	6	0	20	16

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI7A1	Piping and instrumentation Diagram	PE	3	3	0	0	3
2.	20EI7A2	Industrial IOT	PE	3	3	0	0	3
3.	20EI7A3	Smart and Wireless Instrumentation	PE	3	3	0	0	3
4.	20EI7A4	Introduction to Machine learning	PE	3	3	0	0	3
5.	20EE7A2	Fibre Optics and Laser Instruments	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20EI7B1	Power plant Instrumentation	PE	3	3	0	0	3
2	20EI7B2	Mechatronics Engineering	PE	3	3	0	0	3
3	20EI7B3	Adaptive Control	PE	3	3	0	0	3
4	20EE7B3	VLSI Design	PE	3	3	0	0	3
5	20IT7B1	Cyber physical system	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI8A1	Image processing	PE	3	3	0	0	3
2.	20EI8A2	Unit Operations and Control	PE	3	3	0	0	3
3.	20EI8A3	Energy conversion Techniques	PE	3	3	0	0	3
4.	20EI8A4	MEMS	PE	3	3	0	0	3
5.	20EC8A3	Robotics and Automation	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EI8B1	Instrumentation in petrochemical industries	PE	3	3	0	0	3
2.	20EI8B2	Instrumentation in iron & steel industry	PE	3	3	0	0	3
3.	20EE8B4	Micro controller based system design	PE	3	3	0	0	3
4.	20EE8B6	Fundamentals of Nano Science	PE	3	3	0	0	3
5.	20HS7A2	Total Quality Management	PE	3	3	0	0	3

OPEN ELECTIVE – II OFFERED TO OTHER DEPARTMENT

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20OE705	Logic and Distributed Control System	OE	3	3	0	0	3
2.	20OE706	Industrial computer Networks	OE	3	3	0	0	3
3.	20OE707	Modern Electronic Instrumentation	OE	3	3	0	0	3
4.	20OE708	Instrumentation for Agro food industry	OE	3	3	0	0	3

LIST OF OPEN ELECTIVE II (VII SEMESTER) for EIE Students

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20OE107	Autonomous Electric Vehicles	OE	3	3	0	0	3
2.	20OE108	Industrial Safety Practices	OE	3	3	0	0	3
3.	20OE205	Industrial Energy auditing and Management	OE	3	3	0	0	3
4.	20OE306	Consumer Electronics	OE	3	3	0	0	3
5.	20OE407	Computer Graphics	OE	3	3	0	0	3
6.	20OE408	Essentials of Data Analytics	OE	3	3	0	0	3
7.	20OE506	Principles of Cyber Physical System	OE	3	3	0	0	3
8.	20OE508	Introduction to User Interface design	OE	3	3	0	0	3
9.	20OE605	Lean Manufacturing Practices	OE	3	3	0	0	3
10.	20OE606	Modern Technologies for vehicles	OE	3	3	0	0	3

20EI701	PLC and DCS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an introductory knowledge on Programmable Logic Controller (PLC) and their programming languages
- To give adequate knowledge about applications of PLC
- To give basic knowledge about Computer Controlled Systems
- To give basic knowledge on the architecture and local control unit of Distributed Control System (DCS)
- To give adequate information with respect to interfaces used in DCS

PRE-REQUISITE: NIL

UNIT-I PROGRAMMABLE LOGIC CONTROLLER 9

Evolution of PLCs – Components of PLC – Architecture of PLC – Discrete and analog I/O modules – Programming languages -Ladder diagram – Function block diagram (FBD) - Programming timers and counters

UNIT-II APPLICATIONS OF PLC 9

Instructions in PLC – Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions – Case studies in PLC

UNIT - III COMPUTER CONTROLLED SYSTEMS 9

Basic building blocks of computer controlled systems – Data acquisition system – Supervisory control – Direct digital control- SCADA - Hardware and software, Remote terminal units, Master Station and Communication architectures.

UNIT - IV DISTRIBUTED CONTROL SYSTEM 9

DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities

UNIT - V INTERFACES IN DCS 9

Operator interfaces - Low level and high level operator interfaces – Engineering interfaces – Low level and high level engineering interfaces – Foundation field bus- HART protocol interface- Profibus interface-Factors to be considered for selecting DCS– Case studies in DCS

TOTAL: 45 PERIODS

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Fifth edition, 2019
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 2016

REFERENCES:

1.T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005
2. Krishna Kant, Computer Based Industrial Control, Second revised edition, Prentice Hall of India, New Delhi, 2011.
3. John W. Webb and Ronald A. Reis, 'Programmable Logic Controllers, First edition, Pearson Education India, New Delhi, 2015.
4.Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems”, Newnes, 1st Edition, 2004.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PLC and DCS													**Course Code : 20EI701**		
CO	**Course Outcomes**												**Unit**	**K-CO**	**POs**	**PSOs**
C401.1	Explain architecture & components of PLC and PLC programming languages												1	K2	1,2	1,2
C401.2	Explain various instructions used in PLC												2	K2	1,2	1,2
C401.3	Develop ladder programming for industrial sequential applications.												2	K3	1,2,3,5	1,2
C401.4	Explain building blocks of computer-controlled systems and SCADA												3	K2	1,2	1,2
C401.5	Explain various architectures of DCS												4	K2	1,2	1,2
C401.6	Explain various operator interfaces in DCS												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C401.1	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-	
C401.2	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-	
C401.3	3	2	1	-	2	-	-	-	-	-	-	-	2	2	-	
C401.4	2	1		-	-	-	-	-	-	-	-	-	2	2	-	
C401.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C401.6	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-	

20EI702	INSTRUMENTATION SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain signal conditioning circuits for various sensors
- Design data logger and PID controller
- Design orifice and control valve sizing for different services
- Explain about the working about various transmitters
- Design of alarm and annunciation circuits
- Explain about safety Instrumentation

PRE-REQUISITE:
Course code: 20EI402
Course Name: Transducer Engineering

UNIT-I DESIGN OF SIGNAL CONDITIONING CIRCUITS 9

Design of V/I Converter and I/V Converter – Signal conditioning circuit for Thermocouple, RTD, Thermistor and strain gauge - linearization of Thermocouple - Design of Air-purge Level Measurement – Design of Cold Junction Compensation circuit for Thermocouple.

UNIT-II TRANSMITTERS FOR INSTRUMENTATION SYSTEM 9

Variable capacitance transmitters - electrical strain gage transmitters - piezoresistive transmitters-flapper **-** nozzle transmitters – differential pressure transmitter (DPT) -digital transmitters - HART transmitters **-** temperature transmitter **-** safety transmitters

UNIT - III DESIGN OF DATA LOGGER AND ELECTRONIC CONTROLLERS 9

Design of ON / OFF Controller using Linear Integrated Circuits - Electronic P, PI, PD, PID Controller – Micro controller based Data Logger – PC based Data Acquisition System.

UNIT - IV ORIFICE AND CONTROL VALVE SIZING 9

Design of Orifice, Venturi and Rotameter - flow nozzle sizing - Liquid, Gas and steam services – Control valve sizing – Liquid, Gas and steam services.

UNIT - V WIRELESS INSTRUMENTATION 9

Wireless Instrument and sensor – Wireless sensor network architecture – Intelligent wireless sensor- Wireless data loggers – Wireless Integrated sensor networks – Power consideration for wireless Instruments.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Control Valve Handbook, "Emerson Process Management", Fisher Controls International, 4th Edition 2005.
2. Bela G. Liptak, "Instrument Engineers Handbook - Process Control and Optimization", CRC Press, 4th Edition, Vol.2, 2008.

REFERENCES:

1. C. D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson education India, 2015.
2.Industrial Pressure, Level, and Density Measurement - Donald R. Gillum, 2nd edition, ISA press Digitized 2011.
3.Thakore and Bhatt, "Introduction to Process Engineering and Design",TATA McGraw- Hill, 2008
4. Halit Eren , "Wireless Sensors and Instruments Networks, Design, and Applications",CRC Press, 2006

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INSTRUMENTATION SYSTEM DESIGN													Course Code : 20EI702		
CO	Course Outcomes												Unit	K-CO	POs	PSOs
C402.1	Develop V/I and I/V converters and signal conditioning circuits for various sensors												1	K3	1,2,3	1,2
C402.2	Discuss different types of transmitters and instrumentation system												2	K2	1,2	1,2
C402.3	Discuss the design and development of Electronics controllers												3	K2	1,2	1,2
C402.4	Explain data loggers and Data Acquisition Cards.												3	K2	1,2	1,2
C402.5	Develop orifice and control valve sizing for different services												4	K3	1,2.3,5	1,2
C402.6	Explain about Wireless sensor network architecture												5	K2	1,2	1,2
CO-PO mapping																
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
C402.1	3	2	1	-	-	-	-	-	--	-	-	-	2	2	-	
C402.2	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-	
C402.3	2	1	-	-	-	-	-	-	-	-	-	--	2	2	-	
C402.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C402.5	3	2	1	-	1	-	-	-	-	-	-	-	2	2	-	
C402.6	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-	

20EI7L1	INDUSTRIAL AUTOMATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To familiarize programming languages in PLC
- To familiarize Delta /Siemens/ ABB PLC softwares
- To give adequate knowledge in ladder programming
- To develop ladder programming for a given application
- To demonstrate control of process using PLC

PRE-REQUISITE: NIL

LIST OF EXPERIMENTS:

1. Implementing simple logic circuits in PLC
2. Implementing Mathematical Operations in PLC
3. Programming counter operations in PLC
4. Programming timer operations in PLC
5. Programming Jump-to-subroutine & return operations in PLC
6. Traffic Light Control Operation in PLC
7. Bottle Filling Control Operation in PLC
8. Forward & Reversal of DC Motor Direction using PLC
9. ON/OFF Controller for Thermal Process using PLC
10. Study of configuring HMI with PLC

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	NAME OF THE EQUIPMENT	Qty.
1.	Personal computers	10
2.	Delta PLC	1
3.	Siemens PLC	1
4.	HMI	1
5.	WPL software / Semantic software/ RS logics	1

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INDUSTRIAL AUTOMATION LABORATORY		Course Code : 20EI7L1			
CO	**Course Outcomes**	**Exp.No**	**K-CO**	**POs**	**PSOs**
C406.1	Develop ladder program for a given Boolean expression & mathematical Operations	1,2	K3	1,2,3,5,12	1,2
C406.2	Develop a ladder program for a given sequence of operation using counter & timer	3,4	K3	1,2,3,5,12	1,2
C406.3	Develop a ladder program for a given sequence using program control instructions	5	K3	1,2,3,5,12	1,2
C406.4	Develop a ladder program for a given event driven applications	6,7,8	K3	1,2,3,5,12	1,2
C406.5	Demonstrate ON/OFF Controller for Thermal Process using PLC	9	K3	1,2,3,5,12	1,2
C406.6	Demonstrate the configuration of HMI with PLC	10	K3	1,2,3,5,12	1,2

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C406.1	3	2	1	-	2	-	-	-	--	-	-	1	2	2	-
C406.2	3	2	1	-	2	-	-	-	--	-	-	1	2	2	-
C406.3	3	2	1	-	2	-	-	-	-	-	-	1	2	2	-
C406.4	3	2	1	-	2	-	-	-	-	-	-	1	2	2	-
C406.5	3	2	1	-	3	-	-	-	-	-	-	1	2	2	-
C406.6	3	2	1	-	3	-	-	-	--	-	-	1	2	2	-

20EI7L2	INSTRUMENTATION SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To acquire knowledge in design of various signal conditioning circuits and power supplies.
- To know about the design of linearizing and cold–junction compensation circuit for thermocouples
- To acquire knowledge in design of signal conditioning circuit for RTD, thermocouple and strain gauge
- To acquire knowledge design of PI & PD controller using operational amplifier
- To acquire knowledge design of PCB layout using Dip trace software

PRE-REQUISITE:

Course code: 20EE403 & 20EI402
Course Name: Linear Integrated Circuits & Transducer Engineering

LIST OF EXPERIMENTS:

1. Design of V/I & I/V converters and Instrumentation amplifier
2. Design of active filters – LPF& HPF
3. Design of regulated power supply
4. Design of 2 bit flash type ADC
5. Design of signal conditioning circuit for strain gauge
6. Design of signal conditioning circuit for thermocouple and RTD
7. Design of linearizing circuits and cold–junction compensation circuit for thermocouples
8. Design of PI & PD controller using operational amplifier
9. Design of a multi-channel data acquisition system
10. Design of PCB layout using Dip trace software

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:		
S.No.	**NAME OF THE EQUIPMENT**	**Qty.**
1.	Operational amplifiers (IC 741)	sufficient
2.	Quad Operational amplifiers, Regulator IC 7805 and resistors, diodes, capacitors	Sufficient
3.	CRO	10
4.	Thermocouple & RTD	Each 2
5.	Bonded strain gauge	Each 1
6.	Bread board	10
7.	Signal generator	10
8.	General Purpose PCB	10
9.	Dip Trace Software (Open source)	

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INSTRUMENTATION SYSTEM DESIGN LABORATORY													**Course Code : 20EI7L2**		
CO	**Course Outcomes**											**Unit**	**K-CO**	**POs**	**PSOs**
C407.1	Develop op amp based signal conditioning circuits and filters.											1,2	K3	1,2,3,5,12	1,2
C407.2	Develop regulated power supply using LM 78xx/79xx & LM723 and A/D converters											3,4	K3	1,2,3,5,12	1,2
C407.3	Develop signal conditioning circuit for strain gauge, thermocouple & RTD											5,6	K3	1,2,3,5,12	1,2
C407.4	Develop linearizing circuits and cold–junction compensation circuit for thermocouples											7	K3	1,2,3,5,12	1,2
C407.5	Develop PI & PD controller using OPAMP and multi channel data acquisition											8,9	K3	1,2,3,5,12	1,2
C407.6	Develop PCB layout using Dip trace software											10	K3	1,2,3,5,12	1,2
CO-PO mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C407.1	3	2	1	-	2	-	-	-	--	-	-	1	2	2	-
C407.2	3	2	1	-	2	-	-	-	--	-	-	1	2	2	-
C407.3	3	2	1	-	2	-	-	-	-	-	-	1	2	2	-
C407.4	3	2	1	-	2	-	-	-	-	-	-	1	2	2	-
C407.5	3	2	1	-	3	-	-	-	-	-	-	1	2	2	-
C407.6	3	2	1	-	3	-	-	-	--	-	-	1	2	2	-

Professional Elective III

		L	T	P	C
20EI7A1	**PIPING AND INSTRUMENTATION DIAGRAM**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce various flow sheet design using process flow diagram.
- To impart knowledge on P&I D symbols for pumps, compressors and process vessels.
- To teach the line diagram symbols, logic gates of instruments.
- To learn the simulation software for P&ID implementations

PRE-REQUISITE:

Course code: 20EI601
Course Name: Process control

UNIT-I FLOW SHEET DESIGN 9

Introduction to P&I diagram- Anatomy of P & I sheets, Types of flow sheets, flow sheet presentation, flow sheet symbols, line symbols and designation, process flow diagram, synthesis of steady state flow sheet, flow sheet software.

UNIT-II P&ID PREPARATION 9

P & I D Symbols, line numbering, line schedule, P&I D development, various stages of P&I D, P&I D for pumps, compressors process vessels, absorber, evaporator.

UNIT - III INTERLOCKS FOR PROCESS OPERATIONS 9

Introduction, need for interlocks, types of interlocks, interlock for pumps, compressor, heater-control system for heat exchanger, distillation column.

UNIT - IV INSTRUMENT LINE DIAGRAM 9

General rules in drawing P & IDs – pipes or other flow conductors, equipments, instruments and signals. Line diagram symbols, logic gates, representation of line diagram, Introduction to PROCAD

UNIT - V APPLICATION OF P& ID'S 9

Applications of P& ID in design state, construction stage, commissioning state, operating stage, revamping state, applications of P&ID in HAZAMPS and risk analysis

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ernest E. Ludwig, Applied Process Design for Chemical and Petrochemical Plants Vol-1, Gulf
Publishing Company, Hoston,3rd Edition,1995.
2. Max. S. Peters and K.D. Timmerhaus, Plant Design and Economics for Chemicial Engineers,
McGraw Hill Inc., New York, Fifth edition 2017.
3. Moe Toghraei., Piping and Instrumentation Diagram Development., Wiley-AIChe Publication 2019.

REFERENCES:

1. A.N. Westerberg et al., Process Flow sheeting, Cambridge University Press, NewDelhi,2011.
2. Jagadeesh Pandiyan., Introduction to Smart Plant (R) P&ID: The Piping and Instrumentation Diagrams (P&ID) Handbook, APJ Books Publisher, 2020 Edition,
3. Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill, New Delhi,1982.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PIPING AND INSTRUMENTATION DIAGRAM													**Course Code: 20EI7A1**		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
C404A1.1	Explain the concepts of flow sheet design												1	K2	1,2	1,2
C404A1.2	Explain the concepts of P&I diagram standards.												2	K2	1,2	1,2
C404A1.3	Explain the concepts of interlocks and process operation												3	K2	1,2	1,2
C404A1.4	Discuss different fittings for instruments installation used for the preparation of P&IDs												4	K2	1,2	1,2
C404A1.5	Discuss the application of software for preparation of P&IDs.												5	K2	1,2	1,2
C404A1.6	Develop P & ID diagram for industrial processes.												5	K3	1,2,3,5,12	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C404A2.1	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-	
C404A2.2	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-	
C404A2.3	2	1	-	-	-	-	-	-	-	-	-	--	2	2	-	
C404A2.4	2	1		-	-	-	-	-	-	-	-	-	2	2	-	
C404A2.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C404A2.6	3	2	1	-	1	-	-	-	--	-	-	1	2	2	-	

20EI7A2	INDUSTRIAL IOT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce IIoT in the new economy
- To explain IIoT perspective in thinking and building solutions for real world problems
- To introduce the tools and techniques that enable IIoT solution
- To explain various Security aspects in IIoT applications

PRE-REQUISITE: NIL

UNIT-I INTRODUCTION **9**

Introduction to IOT & IIOT, IOT Vs IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, People &Process, Hype cycle, IOT Market, Trends& future Real life examples.

UNIT-II IIoT ARCHITECTURES 9

IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking

UNIT - III IIoT ANALYTICS 9

Introduction to Big Data Analytics and Software Defined Networks, Basics of Data Science-Supervised, Unsupervised and Reinforcement Learning, R Programming, Data Management with Hadoop

UNIT - IV IIoT SECURITY 9

Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT, Network security techniques Management aspects of cyber security

UNIT - V CASE STUDY 9

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Case studies: Milk Processing and Packaging Industries, Manufacturing Industries.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017

2. "Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017

REFERENCES:

1.Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018

2.Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications 2. Bernd Scholz-Reiter, Florian,2013

3. Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications,2010.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications,2012.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INDUSTRIAL IOT													**Course Code: 20EI7A2**		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
C404A2.1	Explain the IoT and IIoT concepts												1	K2	1,2	1,2
C404A2.2	Explain the architecture of IIoT												2	K2	1,2	1,2
C404A2.3	Explain the concepts of IIoT analytics												3	K2	1,2	1,2
C404A2.4	Apply R programming for given IIoT applications												3	K3	1,2,3,5	1,2
C404A2.5	Explain the concepts of IIoT security techniques.												4	K2	1,2	1,2
C404A2.6	Explain various IIoT tools and techniques for given Industrial applications												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C404A2.1	2	1	-	-	-	-	-	-	--	-	-	-	1	1	-	
C404A2.2	2	1	-	-	-	-	-	-	--	-	-	-	1	1	-	
C404A2.3	2	1	-	-	-	-	-	-	-	-	-	--	1	1	-	
C404A2.4	3	2	1	-	1	-	-	-	-	-	-	-	1	1	-	
C404A2.5	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
C404A2.6	2	1	-	-	-	-	-	-	--	-	-	-	1	1	-	

20EI7A3	SMART AND WIRELESS INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the technologies and applications for the emerging domain of Smart and wireless Instrumentation.
- To explain design aspects of various layers in the WSN protocol.
- To explain various node architectures in WSN
- To familiarize the mode of communication used in the design of WSN.
- To elaborate the applications of various smart and wireless systems.

PRE-REQUISITE: NIL

UNIT-I INTRODUCTION **9**

Smart Instrumentation-Materials for automation systems – Smart Sensor – Classifications-Smart transmitter, Wireless Sensor Networks, History of Wireless Sensor networks (WSN), Communication in a WSN, important design constraints of a WSN like Energy, Self Management, Wireless Networking, Decentralized Management, Design Constraints, Security etc.

UNIT-II NODE ARCHITECTURE 9

Application specific integrated circuit, field programmable gate array (FPGA), comparison, communication interfaces, serial peripheral interface, inter integrated circuit, the IMote node architecture, The XYZ node architecture, the Hogthrob node architecture.

UNIT - III FUNDAMENTALS OF WIRELESS DIGITAL COMMUNICATION 9

Basic components, source encoding, the efficiency of a source encoder, pulse code modulation and delta modulation, channel encoding, types of channels, information transmission over a channel, error recognition and correction, Development of Wireless Sensor Network based on Microcontroller and communication device-Zigbee Communication device.

UNIT - IV POWER SOURCES- ENERGY HARVESTING 9

Solar and Lead acid batteries-RF Energy /Harvesting-Energy Harvesting from vibration, Thermal Energy Harvesting-Energy Management Techniques - Calculation for Battery Selection.

UNIT - V APPLICATIONS 9

Structural health monitoring - sensing seismic events, single damage detection using natural frequencies, multiple damage detection using natural frequencies, multiple damage detection using mode shapes, coherence, piezoelectric effect, traffic control,pipeline monitoring, precision agriculture, active volcano, underground mining.

TOTAL: 45 PERIODS

TEXT BOOKS:

1.Fundamentals of wireless sensor networks : theory and practice - Waltenegus Dargie, Christian Poellabauer, A John Wiley and Sons, Ltd.,2010.
2. Smart Sensors, Measurement and Instrumentation , Subhas Chandra Mukhopadhyay, Springer Heidelberg, New York, Dordrecht London, 2014.

REFERENCES:

1.Wireless Sensors and Instruments: Networks, Design and Applications, Halit Eren, CRC Pr Taylor and Francis Group, E- Publication 2018.
2.Uvais Qidwai, Smart Instrumentation: A data flow approach to Interfacing“, Chapman & Hall; 1st edition, 2019.
3. Wireless Sensor Networks: Architectures and Protocols, Edgar H. Callaway Jr. and Ed gar H. Callaway, 1st Edition, Auerbach Publications, 1st edition 2003.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SMART AND WIRELESS INSTRUMENTATION		**Course Code:20EI7A3**			
CO	**Course Outcomes**	**Unit No**	**K-CO**	**POs**	**PSOs**
C404A3.1	Examine Smart and Wireless Instrumentation with respect to various performance parameters.	1	K2	1,2	1,2
C404A3.2	Demonstration of various Node architectures.	2	K2	1,2	1,2
C404A3.3	Demonstration of Fundamentals of wireless digital communication	3	K2	1,2	1,2
C404A3.4	Discuss power requirement for a given WSN	4	K2	1,2	1,2
C404A3.5	Develop Applications using WSN (Wireless sensor Network).	4	K2	1,2	1,2
C404A3.6	Demonstrate an ability to design strategies as per needs and specifications	5	K2	1,2	1,2

CO-PO mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C404A3.1	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C404A3.2	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C404A3.3	2	1	-	-	-	-	-	-	-	-	-	--	2	2	-
C404A3.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C404A3.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C404A3.6	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-

20EI7A4	INTRODUCTION TO MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of Machine Learning for various problem solving
- To familiarize with various classification of supervised learning
- To familiarize with various classification of Unsupervised learning
- To learn about various classification of Reinforced learning Algorithms
- To know about aapplications of machine learning

PRE-REQUISITE: NIL

UNIT-I INTRODUCTION 9

Introduction to Machine Learning – Working – feature - Need for Machine Learning, Applications of Machine learning. Datasets for Machine Learning - Need of Dataset. Introduction to types of Learning- Supervised Learning- Unsupervised Learning- Reinforced Learning - Performance metrics in Machine Learning

UNIT-II SUPERVISED LEARNING 9

Supervised Learning Algorithm- Binary Classification - Regression- Linear regression, Gradient Descent- Choosing Step size, Logistic Regression, Support Vector Machine, Decision Tree, Random Forest , K - Nearest Neighbours ,Naïve Bayes Algorithm.

UNIT - III UNSUPERVISED LEARNING 9

Unsupervised Learning Algorithm - K-means clustering, Principle Component Analysis, Independent Component Analysis, Singular value decomposition. Neural Networks.

UNIT - IV REINFORCED LEARNING 9

Introduction to Reinforced Learning terminology, component, working of Reinforcement Learning. Reinforced Learning Algorithm – Approaches, types- positive type, negative type . Learning Models- Introduction to Markov decision process (MDP), state and action value functions - Application of Reinforced Learning

UNIT - V Case Studies 9

Case studies (Quantitative Approach): Brain Tumour Prediction, breast cancer detection - Dimensionality Reduction: Analyze PCA for the appropriate data set.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press 3rd Edition 2014.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, CRC Press, 2009.

REFERENCES:

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar ”Foundations of Machine Learning, MIT Press, 2012
3.Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong “Mathematics for Machine Learning” , Cambridge University Press, 2020
4.Gopal Sakarkar, Gaurav Patil and Prateek Dutta. “Machine Learning Algorithms using Python Programming” Nova Science Publishers Newyork,2021.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INTRODUCTION TO MACHINE LEARNING														**Course Code : 20EI7A4**		
CO	**Course Outcomes**													**Unit No**	**K-CO**	**POs**	**PSOs**
C404A4.1	Explain the paradigms of Machine Learning and discuss the application of Machine Learning Applic**ation**													1	K2	1,2	1,2
C404A4.2	Apply the regression algorithms to predict the dependent variable based on the independent variable.													2	K3	1,2,3	1,2
C404A4.3	Apply the classification algorithms to build a model that accurately predicts the class labels of new instances based on their features.													2	K3	1,2,3	1,2
C404A4.4	Apply the unsupervised Learning algorithm for clustering problems and and discuss Principle Component Analysis to identify patterns in a data set and extract the features without losing their traits.													3	K3	1,2,3	1,2
C404A4.5	Explain the types of reinforced Learning algorithm and discuss its Applications													4	K2	1,2	1,2
C404A4.6	Discuss the different case studies using Machine Learning Algorithms													5	K2	1,2	1,2
CO-PO mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**		
C404A4.1	2	1	-	-	-	-	-	-	-	-	-	1	1	1	-		
C404A4.2	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-		
C404A4.3	3	2	1	-	-	-	-	-	-	-	-	1	1	1	-		
C404A4.4	3	2	1	-	-	-	-	1	-	-	-	1	1	1	-		
C404A4.5	2	1	-	-	-	-	-	1	-	-	-	1	1	1	-		
C404A4.6	2	1	-	-	-	1	-	-	1	-	-	1	1	1	-		

20EE7A2	FIBRE OPTICS AND LASER INSTRUMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

PRE-REQUISITE: NIL

UNIT - I OPTICAL FIBRES AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode – Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers – fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses– Dispersion – Connectors and splicers – Fibre termination – Optical sources: Light Emitting Diode(LED) – Optical detectors: PIN Diode.

UNIT - II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) – Interferometric method of measurement of length –Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT - III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT - IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting –Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process

Of Material Removal.

UNIT - V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, January 2014.
2. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.
3. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.

REFERENCES:

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, Fifth edition,2017.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2012.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
4. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
6. Keiser, G., "Optical Fiber Communication", McGraw-Hill, 5th Edition, 2017.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FIBRE OPTICS AND LASER INSTRUMENTS		Course Code : 20EE7A2			
CO	**Course Outcomes**	**Unit No**	**K-CO**	**POs**	**PSOs**
C404A5.1	Explain the principle, transmission, dispersion and attenuation characteristics of optical fibers	1	K2	1,2	1,2
C404A5.2	Explain the principle of Fibre Optical sources and Optical detectors.	2	K2	1,2	1,2
C404A5.3	Illustrate the optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.	3	K2	1,2	1,2
C404A5.4	Describe the Fiber Scattering loss Measurement, Fiber Absorption Measurement and Fiber dispersion measurements	4	K2	1,2	1,2
C404A5.5	Discuss the laser theory and laser generation system.	4	K2	1,2	1,2
C404A5.6	Explain the laser theory for the selection of lasers for a specific Industrial and medical application.	5	K2	1,2	1,2

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C404A5.1	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C404A5.2	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C404A5.3	2	1	-	-	-	-	-	-	-	-	-	--	2	2	-
C404A5.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C404A5.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C404A5.6	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-

Professional Elective IV

		L	T	P	C
20EI7B1	**POWER PLANT INSTRUMENTATION**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To make the students familiarize about various power generation methods.
- To understand about measurement of various parameters in power plants.
- To impart knowledge about the different modes of boiler and turbine control.
- To familiarize the student about the nuclear power plant instrumentation.

PRE-REQUISITE: NIL

UNIT-I POWER GENERATION METHODS 9

Brief survey of methods of power generation: hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants: building blocks, details of boiler processes P&I diagram of boiler – cogeneration.

UNIT-II MEASUREMENTS IN POWER PLANTS 9

Electrical measurements: current, voltage, power, frequency, power factor – non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature – smoke density measurement – Flue gas oxygen analyzer – pollution monitoring instruments.

UNIT - III FURNACE AND BOILER CONTROL 9

Coal handling: Pulverisers - Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems - Combustion control: Fuel/Air ratio - drum level measurement methods - steam temperature control, Deaerator control and Interlocks in Boiler.

UNIT - IV TURBINE CONTROL 9

Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - steam pressure control - lubricant oil temperature - cooling system.

UNIT - V NUCLEAR POWER PLANT INSTRUMENTATION 9

Introduction-Nuclear physics-Classification of nuclear reactors-Basic reactor systems-P&I diagram of Nuclear power plant-Radiation detection instruments- nuclear reactor control systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. An Introduction to Thermal Power Plant Engineering and Operation: For Power Plant Professionals, P.K.Das & A.K.Das, Notion Press; 1st edition, 2018.
2.Sam G. Dukelow, The control of Boilers, instrument Society of America, 2nd Edition,1991.

REFERENCES:

1.Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 3rd Edition 2017.
2. Krishnaswamy KM, Bala P, Bala MP, “Power Plant Instrumentation,” Prentice Hall, 2013
3. Elonka.S.M.and Kohal A.L., Standard Boiler Operations, McGraw-Hill, New Delhi, 2001.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : POWER PLANT INSTRUMENTATION		Course Code : 20EI7B1			
CO	**Course Outcomes**	**Unit No**	**K-CO**	**POs**	**PSOs**
C405B1.1	Explain various power generation process	1	K2	1,2	1,2
C405B1.2	Describe measurement of electrical & non electrical parameters in power plants.	2	K2	1,2	1,2
C405B1.3	Explain various analyzers used in power plants.	2	K2	1,2	1,2
C405B1.4	Explain various furnace control schemes	3	K2	1,2	1,2
C405B1.5	Describe various boiler & turbine control loops	4	K2	1,2	1,2
C405B1.6	Discuss about the nuclear power plant instrumentation.	5	K2	1,2	1,2

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C405B1.1	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C405B1.2	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C405B1.3	2	1		-	-	-	-	-	-	-	-	--	2	2	-
C405B1.4	2	1		-	-	-	-	-	-	-	-	-	2	2	-
C405B1.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C405B1.6	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-

20EI7B2	MECHATRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain Mechatronics approach to modern engineering design
- To explain various sensors & actuators used in Mechatronics system and its selection
- To explain the applications of PLC & Microprocessor in Mechatronics system
- To describe the components of machine vision system
- To discuss the applications of Mechatronics in Engineering & Technology

PRE-REQUISITE:

Course code: 20EI402
Course Name: Transducer Engineering

UNIT-I INTRODUCTION **9**

Mechatronics – Definition and key issues – Evolution – Elements – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics - Mechatronics approach to modern engineering design

UNIT-II SENSORS AND TRANSDUCERS 9

Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors- Proximity and velocity sensors – Signal processing – Data display– Selection of sensor

UNIT - III ACTUATION SYSTEMS 9

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages.- Actuators: Mechanical types – Applications – Electrical types – Applications – Pneumatic and hydraulic systems – Applications – Selection of actuators

UNIT - IV CONTROL SYSTEMS 9

Review of controllers (on/off, P,PI,PD,PID) – Programmable logic controllers – Applications – Ladder diagrams – Microprocessor applications in mechatronics – components of machine vision - applications

UNIT - V CASE STUDIES 9

Mechatronics in Manufacturing – Automobiles – Medical – building automation - Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bolton, N., "Mechatronics Electronic Control system for Mechanical and Electrical Engineering", Pearson education, 6th edition, 2019.
2. Dradly, D.A., Dawson, D., Burd, N.C. and Loader, A.J., "Mechatronics: Electronics in Products and Processes", Chapman and Hall, 1993.

REFERENCES:

1. Galip Ulsoy A. and Devires W.R., "Microcomputer Applications in Manufacturing", John wiley, 1989.
2. James Harter, "Electromechanics: Principles, Concepts and Devices", Pearson 2nd Edition, 2003.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MECHATRONICS ENGINEERING													**Course Code : 20EI7B2**		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
C405B2.1	Discuss the Mechatronics approach to modern engineering design												1	K2	1,2	1,2
C405B2.2	Explain various sensors used in mechatronics system and its selection												2	K2	1,2	1,2
C405B2.3	Discuss various actuators used in the development of Mechatronics system												3	K2	1,2	1,2
C405B2.4	Explain applications of PLC & Microprocessor in mechatronics system												4	K2	1,2,	1,2
C405B2.5	Describe the components of machine vision system												5	K2	1,2,	1,2
C405B2.6	Discuss the applications of Mechatronics in Engineering & Technology												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C405B2.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C405B2.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C405B2.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C405B2.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C405B2.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C405B2.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	

20EI7B3	ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand various adaptive control schemes and Non-parametric identification methods
- To learn about various parametric identification methods
- To know about concepts of self-tuning regulators
- To learn about MRAC using MIT rule and Lyapunov theory
- To learn about applications of adaptive controller

PRE-REQUISITE: NIL

UNIT-I INTRODUCTION 9

Introduction to adaptive control – Effects of process variations – Adaptive control schemes – Adaptive control problem – Non-parametric identification – Step response method – Impulse response method – Frequency response method

UNIT-II PARAMETRIC IDENTIFICATION 9

Linear in parameter models – ARX – ARMAX – ARIMAX – Least square estimation – Recursive least square estimation – Extended least square estimation – Maximum likelihood estimation – Introduction to non-linear systems identification – Pseudo random binary sequence

UNIT - III SELF-TUNING REGULATOR 9

Deterministic in-direct self-tuning regulators – Deterministic direct self-tuning regulators – Introduction to stochastic self-tuning regulators – Stochastic indirect self-tuning regulator

UNIT - IV MODEL REFERENCE ADAPTIVE CONTROL 9

The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self tuning regulator

UNIT - V TUNING OF CONTROLLERS AND CASE STUDIES 9

Design of gain scheduling controller – Auto-tuning of PID regulator – Stability analysis of adaptive controllers – Application of adaptive control in chemical reactor, distillation column and variable area tank system

TOTAL: 45 PERIODS

TEXT BOOKS:

1.Karl J. Astrom and Bjorn Wittenmark, “Adaptive Control”, 2nd edition, Pearson Education, 2006.
2. Karel J. Keesman, ‘System Identification: An Introduction’, Springer,2011

REFERENCES:

1.Stephanopoulis, G., “Chemical Process Control”, Pearson Education India, 2015.
2.Gang Feng, Rogelio Lozano, “Adaptive Control Systems”,1st edition,Newnes, 1999
3.Hsia, T.C.H.A., “System Identification”, Lexington Books, 1978.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ADAPTIVE CONTROL		Course Code : 20EI7B3			
CO	Course Outcomes	Unit No	K-CO	POs	PSOs
C405B3.1	Explain various adaptive control schemes and Non-parametric identification methods	1	K2	1,2	1,2
C405B3.2	Explain about various parametric identification methods	2	K2	1,2	1,2
C405B3.3	Explain about concepts of self-tuning regulators	3	K2	1,2,5	1,2
C405B3.4	Design MRAC using MIT rule for a given transfer function	4	K3	1,2,3,9	1,2
C405B3.5	Design MRAC using Lyapunov theory for a given transfer function	4	K3	1,2,5,12	1,2
C405B3.6	Explain about applications of adaptive controller	5	K2	1,2,10	1,2

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C405B3.1	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C405B3.2	2	1	-	-	-	-	-	-	--	-	-	-	2	2	-
C405B3.3	2	1	-	-	1	-	-	-	-	-	-	--	2	2	-
C405B3.4	3	2	1	-	-	-	-	-	1	-	-	-	2	2	-
C405B3.5	2	1	-	-	1	-	-	-	-	-	-	1	2	2	-
C405B3.6	2	1	-	-	-	-	-	-	--	1	-	-	2	2	-

20EE7B3	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational Circuits
- To gain knowledge about Sequential logic circuits.
- To educate on Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology
- To learn the different FPGA architectures and testability of VLSI circuits

PRE-REQUISITE:

Course Code: 20EE505
Course Name: Microprocessors, Microcontrollers and Applications

UNIT - I MOS TRANSISTOR PRINCIPLE 9

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams.

UNIT - II COMBINATIONAL LOGIC CIRCUITS 9

Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles.

UNIT - III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design.

UNIT - IV DESIGNING ARITHMETIC BUILDING BLOCKS 9

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff.

UNIT - V IMPLEMENTATION STRATEGIES 9

Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2016.
2. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, Second Edition, Addision Wesley, 2017.

REFERENCES:

1. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Fourth Edition, Prentice Hall of India, 2017.
2. Jacob Baker “CMOS: Circuit Design, Layout, and Simulation, Third Edition”, Wiley IEEE Press, 2010.
3. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits: Analysis & Design”,4th edition, McGraw Hill Education, 2013.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : VLSI DESIGN											**Course Code : 20EE7B3**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C405B4.1	Explain the concepts of digital building blocks using MOS transistor.										1	K2	1,2	-
C405B4.2	Describe combinational MOS circuits and power strategies										2	K2	1,2	-
C405B4.3	Illustrate the concept of Sequential Circuits and low power memory circuits.										3	K2	1,2	-
C405B4.4	Explain the arithmetic building blocks and memory subsystems										4	K2	1,2	-
C405B4.5	Discuss the concept of full custom and semi custom design										5	K2	1,2	-
C405B4.6	Explain the FPGA interconnect routing procedures										5	K2	1,2	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C405B4.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B4.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B4.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B4.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B4.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B4.6	2	1	-	-	-	-	-	-	-	-	-	-	-	-

20IT7B1	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the nature of continuous and discrete systems
- To develop synchronous and asynchronous model of processes
- To specify both safety and liveness requirements in temporal logic
- To debug the correctness of the protocol using model checking
- To develop and analyze model of timed and hybrid systems
- To understand zero behaviors and its hybrid automata

PRE-REQUISITE: NIL

UNIT I INTRODUCTION **9**

Introduction-key features of cyber physical systems- Continuous dynamics: Newtonian mechanics-actor models-properties of systems-feedback control-Discrete dynamics: Discrete systems- Finite state machines

UNIT II SYNCHRONOUS AND ASYNCHRONOUS MODEL **9**

Synchronous model: Reactive components-properties of components-composing components-synchronous design, Asynchronous model- asynchronous processes- asynchronous design primitives- coordination protocols.

UNIT III SAFETY AND LIVENESS REQUIREMENT **9**

Safety specifications- verifying invariants- Enumerative search- Temporal logic- Model checking-reachability analysis- proving liveness

UNIT IV TIMED MODEL AND REAL-TIME SCHEDULING **9**

Timed processes- Timing based protocols: Timing-Based Distributed Coordination-Audio Control Protocol- Timed automata: Model of Timed Automata-Region Equivalence-Matrix-Based Representation for Symbolic Analysis, Real-time scheduling.

UNIT V HYBRID SYSTEMS **9**

Classes of Hybrid Systems-Hybrid dynamic models: Hybrid Processes-Process Composition-Zeno Behaviors-Stability- designing hybrid systems- linear hybrid automata

TOTAL: 45 PERIODS

TEXT BOOKS

1. Rajeev Alur, Principles of cyber-physical systems, The MIT press, 2015
2. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Lulu.com, Second Edition, 2015.

REFERENCE:

1.Sang C.Suh , U.JohnTanik and John N.Carbone , Applied Cyber-Physical systems, Springer,2014

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CYBER PHYSICAL SYSTEMS											Course Code :20IT7B1			
CO	**Course Outcomes**									**Unit**	**K-CO**	**POs**		**PSOs**
C405B5.1	Ability to understand knowledge, opportunities, challenges and Logical Foundations of Cyber Physical Systems.									1	K2	1, 2		1,2
C405B5.2	Ability to develop model for synchronous, asynchronous, continuous and discrete systems.									2	K2	1, 2		1,2
C405B5.3	Ability to identify safety specifications and critical properties of Cyber Physical Systems.									3	K2	1, 2		1,2
C405B5.4	Ability to design and analyze the stability of hybrid systems.									4	K2	1, 2		1,2
C405B5.5	Ability to apply automata for timed systems.									5	K2	1, 2		1.2
C405B5.6	Ability to understand Zeno Behaviors									5	K2	1, 2		1,2
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C405B5.1	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C405B5.2	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C405B5.3	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C405B5.4	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C405B5.5	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C405B5.6	2	1	-	-	-	-	-	-	-	-	-	-	1	1

Professional Elective V

		L	T	P	C
20EI8A1	**IMAGE PROCESSING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

PRE-REQUISITE: NIL

UNIT-I IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.

UNIT-II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT - III IMAGE RESTORATION 9

Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT - IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm

UNIT - V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching

TOTAL: 45 PERIODS

TEXT BOOKS:

1.Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2018.

2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2015.

REFERENCES:

1. Kenneth R. Castleman, Digital Image Processing Pearson, 2007.

2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.

3.William K. Pratt,Digital Image Processing John Wiley, New York, 2007

4. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Cencage India, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : IMAGE PROCESSING													**Course Code : 20EI8A1**		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
C408A1.1	Explain the fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.												1	K2	1,2	1,2
C408A1.2	Explain about various image enhancement techniques.												2	K2	1,2	1,2
C408A1.3	Explain about various image restoration and filtering techniques.												3	K2	1,2	1,2
C408A1.4	Explain basics of segmentation and features extraction techniques.												4	K2	1,2	1,2
C408A1.5	Apply image segmentation algorithm for a given applications												4	K3	1,2,3	1,2
C408A1.6	Explain about compression and recognition methods for color models												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C408A1.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C408A1.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C408A1.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C408A1.4	2	1		-	-	-	-	-	-	-	-	-	2	2	-	
C408A1.5	3	2	1	-	-	-	-	-	-	-	-	-	2	2	-	
C408A1.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	

20EI8B2	UNIT OPERATIONS AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about concepts of various unit operations
- To learn about Combustion processes
- To know about concepts of distillation, drying and refrigeration processes
- To learn about Unit Operations and Control schemes applied to Thermal Power plant
- To learn about Unit Operations and Control schemes applied to industrial process

PRE-REQUISITE: NIL

UNIT-I UNIT OPERATIONS 9

Unit operations-transport of liquids, solids and gases adjusting particle size of bulk solids – Operations On Fluids: Transport of fluids; Mixing and agitation: Mixing of liquids, selection of suitable mixers; Separation: Gravity settling, sedimentation, thickening, double cone classifier, centrifugal separation.

UNIT-II COMBUSTION PROCESSES 9

Combustion processes – heat exchangers – energy balance - material balance – evaporators –crystallization.

UNIT - III OTHER UNIT OPERATIONS 9

Heat exchangers: Single pass and multi pass heat exchangers, condensers, reboilers - Distillation: Binary distillation, controls and operations, Chemical reactors- Drying process – refrigeration process.

UNIT - IV CASE STUDY – I 9

Unit Operations and Control schemes applied to Thermal Power plant - operations & control schemes in paper and pulp industry.

UNIT - V CASE STUDY-II 9

Unit Operations and Control schemes applied to Leather Industry – operations in pharmaceutical industry – iron and steel industry.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Warren L. McCabe, Julian C. Smith and Peter Harriot, Unit Operations of Chemical Engineering, McGraw-Hill International Edition, New York, 7th Edition, 2017.
2. Austin, G.t. shreve's Chemical Process industries, McGraw-Hill International student edition, Singapore, 2017.

REFERENCES:

1. Liptak, B.G., Process measurement and analysis, Chilton Book Company, USA, 1995.
2. Luyben W.C., Process Modeling, Simulation and Control for Chemical Engineers, McGraw-Hill International edition, USA, 1989.
3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, Chemical Process Equipment :Selection and Design, Gulf Professional Publishing, 2010.
4. Balchen ,J.G., and Mumme, K.J., Process Control structures and applications, Van Nostrand Reinhold Co., New York, 1988.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : UNIT OPERATIONS AND CONTROL													Course Code : 20EI8B2		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
C408A2.1	Explain concepts of various unit operations												1	K2	1,2	1,2
C408A2.2	Explain concepts of separation, mixing and agitation												1	K2	1,2	1,2
C408A2.3	Explain about Combustion processes												2	K2	1,2	1,2
C408A2.4	Explain about concepts of distillation, drying and refrigeration												3	K2	1,2	1,2
C408A2.5	Explain about Unit Operations and Control schemes applied to Thermal Power plant												4	K2	1,2	1,2
C408A2.6	Explain about Unit Operations and Control schemes applied to industrial process												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C408A2.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C408A2.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C408A2.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C408A2.4	2	1		-	-	-	-	-	-	-	-	-	2	2	-	
C408A2.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C408A2.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	

20EI8A3	ENERGY CONVERSION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand Conventional energy conversion techniques
- To know about Direct energy conversion systems
- To know about need and necessity of energy storage systems
- To study desirable characteristics of Fuel cells.

PRE-REQUISITE: NIL

UNIT-I INTRODUCTION 9

Reversible and irreversible cycles – Thermodynamics analysis of Carnot – Stirling – Ericsson – Otto – Diesel – Dual – Lenoir – Atkinson – Brayton - Rankine.

UNIT-II CONVERSION OF THERMAL TO ELECTRICAL ENERGY 9

Thermoelectric Converters –Thermionic converters – MHD – Ferro electric converter – Nernst effect generator

UNIT - III CHEMICAL ENERGY TO ELECTRICAL ENERGY 9

Batteries – types – working – performance governing parameters – hydrogen energy – solar photovoltaic cells – applications: Electric vehicle

UNIT - IV ENERGY STORAGE SYSTEMS 9

Energy Storage Technologies - Mechanical energy, Electrical energy, Chemical energy, Thermal energy

UNIT - V FUEL CELLS 9

Basics – types – working - comparative analysis – thermodynamics and kinetics of fuel cell process – performance of fuel cell – applications - advantages and drawbacks

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Archie.W.Culp, Principles of Energy Conversion, McGraw-Hill Inc., 1991, Singapore
2. Kordesch. K, and Simader.G, Fuel Cell and Their Applications, Wiley-Vch, Germany 1996

REFERENCES:

1. Kettari, M.A.Direct Energy Conversion, Addison-Wesley Pub. Co 1997
2. Hart A.B and Womack, G.J.Fuel Cells: Theory and Application, Prentice Hall Ltd., 1989

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ENERGY CONVERSION TECHNIQUES		Course Code : 20EI8A3			
CO	Course Outcomes	Unit No	K-CO	POs	PSOs
C408A3.1	Explain about operation of energy conversion cycles	1	K2	1,2	1,2
C408A3.2	Explain Conventional energy conversion techniques	1	K2	1,2	1,2
C408A3.3	Describe about Direct energy conversion systems	2	K2	1,2	1,2
C408A3.4	Describe about chemical to electrical energy conversion systems	3	K2	1,2	1,2
C408A3.5	Explain about need and necessity of energy storage systems	4	K2	1,2	1,2
C408A3.6	Explain about the performance of fuel cell	5	K2	1,2	1,2

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C408A3.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A3.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A3.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A3.4	2	1		-	-	-	-	-	-	-	-	-	2	2	-
C408A3.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A3.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-

20EI8A4	MEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide adequate knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To explain about the rudiments of Micro fabrication techniques.
- To familiarize various sensors and actuators
- To explain different materials used for MEMS
- To discuss about the applications of MEMS

PRE-REQUISITE: NIL

UNIT-I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT-II SENSORS FOR MEMS 9

Electrostatic sensors – Parallel plate capacitors – Applications – Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow– Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Applications.

UNIT - III ACTUATORS FOR MEMS 9

Inter digitized Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Piezoelectric actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors– Magnetic Actuators – Micro magnetic components.

UNIT - IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching –Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods .

UNIT - V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2006.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, 2002.

REFERENCES:

1. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MEMS		**Course Code : 20EI8A4**			
CO	**Course Outcomes**	**Unit No**	**K-CO**	**POs**	**PSOs**
C408A4.1	Explain about use of semiconductors and solid mechanics to fabricate MEMS devices.	1	K2	1,2	1,2
C408A4.2	Explain about Micro fabrication techniques.	1	K2	1,2	1,2
C408A4.3	Explain about various electric sensors and actuators	2	K2	1,2	1,2
C408A4.4	Explain about various magnetic sensors and actuators	3	K2	1,2	1,2
C408A4.5	Describe about different materials used for MEMS	4	K2	1,2	1,2
C408A4.6	Explain about various applications of MEMS	5	K2	1,2	1,2

CO-PO mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C408A4.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A4.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A4.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A4.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A4.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C408A4.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-

20EC8A3	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the various kinematics and robot dynamics.
- To study the trajectory planning and control for robot.
- To study the control of robots for some specific applications.

PRE-REQUISITE: NIL

UNIT - I BASIC CONCEPTS OF ROBOTS **9**

Introduction of robots – Classification of robots – Present status and future trends – Basic components of robotic system – Mechanisms and transmission – End effectors – Grippers– different methods of gripping – Specifications of robot.

UNIT - II DRIVE SYSTEMS AND SENSORS **9**

Drive system – hydraulic, pneumatic and electric systems – Sensors in robot: Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT - III KINEMATICS AND DYNAMICS OF ROBOTS **9**

2D & 3D Transformation – Scaling – Rotation – Translation – Homogeneous coordinates – multiple transformation – Simple problems – Matrix representation – Forward and Reverse Kinematics of Three Degree of Freedom – Homogeneous Transformations – Inverse kinematics of Robot – Robot Arm dynamics – Basics of Trajectory Planning.

UNIT - IV ROBOT CONTROL **9**

Robot controls – Point to point control – Continuous path control – Intelligent robot – Control system for robot joint – Control actions – Feedback devices – Encoder – Resolver – LVDT – Motion Interpolations – Adaptive control.

UNIT - V ARTIFICIAL INTELLIGENCE IN ROBOTICS **9**

Application of Machine learning – Artificial Intelligence – Expert systems– Tele-robotics and Virtual Reality – Micro and Nanorobots – Unmanned vehicles –Cognitive robotics – Evolutionary robotics – Humanoids.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P. Groover, Nicholas G.Odrey, Mitchel Weiss, Roger N. Nagel and Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2017.
2. J.J.Craig, “Introduction to Robotics- mechanics and control”, Addison-Wesley, Fourth Edition, 2008.

REFERENCES:

1. S.R.Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education, 2009.
2. Richard D. Klafter, A.Thomas, ChriElewski and Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning, 2009.

Course Name :Robotics and Automation		**Course Code :20EC8A3**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C415.1	Explain the basic concepts of robotics.	1	K2	1,2,8,10	3
C415.2	Classify the various sensors used in robotics.	2	K3	1,2,3,8,10	3
C415.3	Explain about the differential kinematic in robotics.	3	K2	1,2,8,9,10	3
C415.4	Classify the various dynamics in robotics.	3	K3	1,2,3,8,10	3
C415.5	Discuss the different controls of robot.	4	K2	1,2,8,9,10	3
C415.6	Apply Artificial Intelligence in the field of robotics.	5	K3	1,2,3,8,10	3

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
C415.1	2	1						2		2					1
C415.2	3	2	1					2		2					2
C415.3	2	1						2	2	2					1
C415.4	3	2	1					2		2					2
C415.5	2	1						2	2	2					1
C415.6	3	2	1					2		2					2

Professional Elective VI

		L	T	P	C
20EI8B1	**INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the concepts of oil recovery and the steps involved in oil gas
- production process.
- To explain about Unit operations relevant to petrochemical industry.
- To discuss about the important derivatives obtained from petroleum products.
- To explain about the selection and maintenance of instruments in petrochemical industry.

PRE-REQUISITE: NIL

UNIT-I OIL EXTRACTION AND OIL GAS PRODUCTION **9**

Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.

UNIT-II UNIT OPERATIONS IN REFINERY 9

Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming –– mathematical Modeling and selection of appropriate control strategy- Alkylation – Isomerization

UNIT - III DERIVATIVES FROM PETROLEUM 9

Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene ––Derivatives from ethylene – Derivatives from propylene.

UNIT - IV PETROLEUM PRODUCTS & ITS MEASUREMENTS 9

BTX from Reformate – Styrene – Ethylene oxide/Ethylene glycol – polyethylene – Polypropylene – PVC production - Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments.

UNIT - V SAFETY IN INSTRUMENTATION SYSTEMS 9

Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Waddams, A.L., “Chemicals from Petroleum”, Wiley, 1973. (digitized in 2007).
2. Liptak, B.G., “Instrumentation in Process Industries”, Chilton Book Company, 2005. (Digitized in 2008.)

REFERENCES:

1.Dr.B.K.Bhaskararao, “A Text on Petro Chemical” Khanna Publishers,2004.
2. Austin, G.T. and Shreeves, A.G.T., “Chemical Process industries”, McGraw-Hill, 2012.
3. Paul Gruhn and Harry Cheddie, “Safety Instrumented Systems: Design, Analysis, and Justification”, 2nd Edition, ISA Press, 2006.
4. Balchen, J.G., and Mumme K.I., “Process Control Structures and Applications”, Von Nostrand Reinhold Company, New York, 1988.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES													**Course Code : 20EI8B1**		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
C409B1.1	Explain oil extraction and oil gas production process												1	K2	1,2	1,2
C409B1.2	Explain about unit operations relevant to refineries												2	K2	1,2	1,2
C409B1.3	Explain the chemical derivatives obtained from petroleum products.												3	K2	1,2	1,2
C409B1.4	Explain various extraction methods of petroleum products												4	K2	1,2	1,2
C409B1.5	Discuss selection and maintenance of measuring instruments												4	K2	1,2	1,2
C409B1.6	Explain safety instrumentation followed in process industries.												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
C409B1.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C409B1.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C409B1.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C409B1.4	2	1		-	-	-	-	-	-	-	-	-	2	2	-	
C409B1.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
C409B1.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	

20EI8B2	INSTRUMENTATION IN IRON & STEEL INDUSTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge in steel making process.
- To understand the concepts of steel rolling.
- To know measurement of Process parameters in steel industries.
- To understand the control methods used in steel industries.
- To know about the computer controlled Process in steel industries.

PRE-REQUISITE: NIL

UNIT-I FLOW DIAGARM AND DESCRIPTION OF PROCESS 9

Raw materials preparation – Iron making blast furnaces – Stoves – Raw steel making – Basic Oxygen furnace – Electric furnace.

UNIT-II STEEL ROLLING METHODS 9

Casting of steel – Primary rolling – Cold rolling and finishing.

UNIT - III MEASUREMENTS AND INSTRUMENTATION IN STEEL PLANTS 9

Measurement of level-pressure – Density – Temperature – Flow weight – Thickness and shape – Graphic displays and alarms

UNIT - IV CONTROL ASPECTS IN STEEL PLANTS 9

Blast furnace stove combustion control system – Gas and water controls in BOF – Stand casting mould level control.

UNIT - V COMPUTER APPLICATIONS 9

Model calculating and logging – Computer Control of Rolling mill– Computer Control of Annealing process – Center utilities dispatch computer.

TOTAL: 45 PERIODS

TEXT BOOKS:

1.Liptak, B.G., “Instrumentation in Processing Industries” Ghilton Book Co., 1973.

REFERENCES:

1. Considine, D.M., “Hand book of Applied Instrumentation”, McGraw-Hill, 1984.
2. Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 3rd edition 2017.
3. D. P. Eckman, “Automatic Process control”, 7th edition, John Wiley, 2003.
4. C. D. Johnson, “Process Control Instrumentation Technology”, 8th edition, Pearson education India, 2015.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INSTRUMENTATION IN IRON & STEEL INDUSTRY		Course Code : 20EI8B2			
CO	**Course Outcomes**	**Unit No**	**K-CO**	**POs**	**PSOs**
C409B2.1	Explain the PI&D diagram for steel making process.	1	K2	1,2	1,2
C409B2.2	Describe steel making process.	1	K2	1,2	1,2
C409B2.3	Explain the concepts of steel rolling process	2	K2	1,2	1,2
C409B2.4	Explain measurement of Process parameters in steel industries.	3	K2	1,2	1,2
C409B2.5	Explain the control methods used in steel industries.	4	K2	1,2	1,2
C409B2.6	Explain computer controlled Process in steel industries	5	K2	1,2	1,2

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C409B2.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C409B2.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C409B2.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C409B2.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C409B2.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
C409B2.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-

20EE8B4	MICRO CONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study about the PIC Microcontroller, its architecture and programming
- Gain knowledge about the interrupts and timer of PIC microcontroller
- Study and understand the peripherals and interfacing devices with microcontrollers
- Get introduced to the concept of ARM processor, its architecture and programming
- Learn the ARM processor organization, execution, implementation and applications

PRE-REQUISITE:

Course Code: 20EE505
Course Name: Microprocessors, Microcontrollers and Applications

UNIT - I INTRODUCTION 9

Introduction to PIC Microcontroller – PIC 16C6x and PIC 16C7x Architecture – PIC16Cxx– - Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.

UNIT - II INTERRUPTS AND TIMERS 9

PIC microcontroller Interrupts - External Interrupts - Interrupt Programming – Loop time subroutine – Timers - Timer Programming – Front panel I/O - Soft Keys – State machines and key switches – Display of Constant and Variable strings.

UNIT - III PERIPHERALS AND INTERFACING 9

I^2C Bus for Peripherals Chip Access – Bus operation - Bus subroutines – Serial EEPROM - – Analog to Digital Converter – UART- Baud rate selection – Data handling circuit – Initialization - LCD and keyboard Interfacing - ADC, DAC, and Sensor Interfacing.

UNIT - IV ARM INTRODUCTION 9

ARM Architecture – ARM programmer's model - ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming – Simple Examples – Architectural Support for Operating systems.

UNIT - V ARM ORGANIZATION 9

3-Stage Pipeline ARM Organization – 5-Stage Pipeline ARM Organization – ARM Instruction Execution - ARM Implementation – ARM Instruction Set – ARM coprocessor interface – Architectural support for High Level Languages – Embedded ARMApplications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mazidi, “PIC Microcontroller and Embedded Systems “Pearson Education”, Second Edition 2021.
2. Steve Furber., “ARM System on Chip Architecture” blication, 2014.

REFERENCES:

1. Martin Bates, “Interfacing PIC Microcontrollers”, Newnes Publication, second Edition 2013.
2. Muhammed Tahir, ”ARM Microprocessor Systems”, Special Indian Edition, CRC Press,2017.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MICROCONTROLLER BASED SYSTEM DESIGN											**Course Code :** 20EE8B4			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C409B3.1	Explain the functional building block of PIC16cxx and formulate the instruction set for simple operations.										1	K2	1,2	1
C409B3.2	Describe the concept of interrupts in PIC micro controllers and Illustrate the interrupt programs										2	K2	1,2	1
C409B3.3	Illustrate the concept of PIC programming to interface I/O devices like LCD, Keyboard, and Sensors etc.,										3	K2	1,2	1
C409B3.4	Explain the programming concepts in ARM processor.										4	K2	1,2	1
C409B3.5	Discuss embedded ARM applications and select an ARM Coprocessor										5	K2	1,2	1
C409B3.6	Describe the concept of Pipeline ARM Organization										5	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C409B3.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20EE8B6	FUNDAMENTALS OF NANO SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept and knowledge of Nano science and Nanotechnology.
- To create awareness of clean room environment & societal implications of Nanotechnology
- To know about preparation methods and nanofabrication techniques
- To know about the different characterization techniques used for Nano systems.
- To understand the significant applications of nanotechnology

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION 9

Overview of Nano scale Science and Technology- Implications on Science, Engineering and society nano structured materials- Properties- Nanotoxicology-Clean room standards.

UNIT - II PREPARARTION ROUTES 9

Preparation of nanoscale materials: precipitation, mechanical milling, colloidal routes, self assembly; vapour phase deposition, CVDs, sputtering, evaporation, molecular beam epitaxy, atomic layer epitaxy.

UNIT - III LITHOGRAPHY FOR NANOSCALE DEVICES 9

Lithography process, optical/UV, electron beam, Ion Beam and x-ray lithography, Nano imprint technique- Scanning probe lithography.

UNIT - IV CHARECTERIZATION TECHNIQUES 9

X-ray and Neutron diffraction technique, Scanning Electron Microscopy plus environmental techniques, Transmission Electron Microscopy including high-resolution imaging, analytical electron microscopy, EDX and EELS, Surface Analysis techniques, XPS, SIMS, Auger.

UNIT - V EVOLVING INTERFACES OF NANO 9

Applications of nanotechnology: NEMS – Nanosensor – nanomedicines –Nano applications in electrical engineering –Nanoelectronics: quantum transport devices, molecular electronics devices, quantum computing ,memory, CNT and its applications, Nano motor, Nano robot, energy efficient battery technology, Nano dielectrics, lighting system, solar cell

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Chattopadhyay K.K and A.N Banerjee, Introduction to Nanoscience and nanotechnology, PHI, 2009
2. T. Pradeep, Nano the essentials, Tata-McGraw Hill Education, 2007

REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Charles P. Poole & Frank, J.Owens, Introduction to nanotechnology, Wiley India, 2007
3. Jan Korwink and Andreas Greiner, Semiconductors for Micro and Nanotechnology: An Introduction for Engineers, Weinheim Cambridge: wiley-VCH,2001
4. N.John Dinardo, Nanoscale Characterization of Surfaces and Interfaces, Second edition, Weinheim Cambridge: wiley-VCH,2000
5. B S Murthy,P Shankar, Baldev Raj, BB Rath& James Murday. 'Text book of Nanoscience and Nano Technology', Universities Press, 2011

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FUNDAMENTALS OF NANO SCIENCE											**Course Code : 20EE8B6**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C409B4.1	Explain the science of nano structured materials										1	K2	1,2	1
C409B4.2	Demonstrate the general methods of nanomaterials preparation										2	K2	1,2	1
C409B4.3	Discuss the types and properties of nanomaterials										3	K2	1,2	1
C409B4.4	Explain the characterization techniques of nanomaterials										4	K2	1,2	1
C409B4.5	Describe the operation of NanoInfoTech and Nanobiotechlogy										5	K2	1,2	1
C409B4.6	Summarize the operation of Nanoparticles for sunbarrier products										5	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C409B4.1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B4.2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B4.3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B4.4	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B4.5	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B4.6	2	1	-	-	-	-	-	-	-	-	-	-	2	-

20HS7A2	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand TQM concepts.
- To know about TQM principles.
- To understand Six Sigma, Traditional tools, New tools, Benchmarking and FMEA.
- To understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
- To apply QMS and EMS in any organization.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION 9

Quality – Need, Evolution, Definitions, Dimensions of product and service quality. TQM - Basic concepts, Framework, Contributions of Deming, Juran and Crosby, Barriers. Quality statements, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

UNIT – II TQM PRINCIPLES 9

Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Teamwork, Quality circles, Recognition and Reward, Performance appraisal, Continuous process improvement - PDCA cycle, 5S, Kaizen, Supplier partnership, Supplier selection, Supplier Rating.

UNIT – III TQM TOOLS AND TECHNIQUES I 9

Traditional tools of quality, New management tools. Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA - Stages, Types.

UNIT – IV TQM TOOLS AND TECHNIQUES II 9

Control Charts, Process Capability, Quality Function Development (QFD), Taguchi quality loss function, TPM - Concepts, improvement needs, Performance measures.

UNIT - V QUALITY SYSTEMS 9

Need for ISO 9000, ISO 9001-2008 Quality System, Elements, Documentation, Quality Auditing, QS 9000 - ISO 14000, Concepts, Requirements and Benefits, TQM Implementation in manufacturing and service sectors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, 5th Edition, 2018.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", Cengage Learning, 8th Edition, 2012.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2nd Edition, 2006.

REFERENCES:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”, CRC Press, 5th Edition, 2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 1st Edition, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2012.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 1st Edition, 2006.
5. Brue G, "Six Sigma for Managers”, Tata-McGraw Hill, 2nd Edition, 2002.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TOTAL QUALITY MANAGEMENT											**Course Code : 20HS7A2**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C409B5.1	Explain basic concepts, TQM framework, Barriers and Benefits of TQM.										1	K3	1,2,11	-
C409B5.2	Explain the TQM Principles for application.										2	K3	1,2,8,11	-
C409B5.3	Discuss the basics of Six Sigma and Traditional tools, New tools, Benchmarking and FMEA.										3	K2	1,2,4,11,12	-
C409B5.4	Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.										4	K3	1,2,3,4,7,11	-
C409B5.5	Illustrate and apply QMS and EMS in any organization.										5	K3	1,2,11,12	-
C409B5.6	Explain the process of implementation of ISO 9000/9001-2008/14000 for given manufacturing, service sector.										5	K3	1,2,11,12	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C409B5.1	2	1	-	-	-	-	-	-	-	-	2	-	-	-
C409B5.2	2	1	-	-	-	-	-	1	-	-	2	-	-	-
C409B5.3	2	1	-	1	-	-	-	-	-	-	2	1	-	-
C409B5.4	2	1	-	2	-	-	1	-	-	-	2	-	-	-
C409B5.5	2	1	-	-	-	-	-	-	-	-	2	1	-	-
C409B5.6	2	1	-	-	-	-	-	-	-	-	2	1	-	-

20EI8L1	PROJECT WORK	L	T	P	C
		0	0	20	10

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 students 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 prepare 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.

OUTCOMES:

• 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.

PRE-REQUISITE: ALL CORE COURSES & LABORATORIES

TOTAL: 300 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROJECT WORK												Course Code : 20EI8L1			
CO	**Course Outcomes**											**Exp**	**K –CO**	**POs**	**PSOs**
C410.1	Identify and apply the real world and societal importance problems in Instrumentation and its allied area.											-	K4	1-12	1,2
C410.2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies											-	K4	1-12	1,2
C410.3	Apply modern engineering tools for solution											-	K4	1-12	1,2
C410.4	Contribute as an individual or in a team in development of technical projects											-	K4	1-12	1,2
C410.5	Develop effective communication skills for presentation of project related activities											-	K4	1-12	1,2
C410.6	Prepare reports and examination following professional ethics											-	K4	1-12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C410.1	3	3	2	1	-	3	3	-	-	-	-	3	3	3	
C410.2	3	3	2	1	-	-	-	-	-	-	-	-	3	3	
C410.3	3	2	1	-	3	-	-	-	-	-	-	-	3	3	
C410.4	3	2	1	-	-	-	-	-	3	-	-	-	3	3	
C410.5	3	2	1	-	-	-	-	-	-	3	-	-	3	3	
C410.6	3	2	1	-	-	-	-	3	-	-	3	-	3	3	

OPEN ELECTIVE – II OFFERED TO OTHER DEPARTMENT

20OE705	LOGIC AND DISTRIBUTED CONTROL SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an introductory knowledge on Programmable Logic Controller (PLC) and their programming languages
- To give adequate knowledge about applications of PLC
- To give basic knowledge about Computer Controlled Systems
- To give basic knowledge on the architecture and local control unit of Distributed Control System (DCS)
- To give basic knowledge in Advance Automation topics

PRE-REQUISITE: NIL

UNIT-I PLC &SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs. SCADA: Remote terminal units- Master station - Communication architectures.

UNIT-II APPLICATIONS OF PLC 9

Instructions in PLC – Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions .

UNIT - III DISTRIBUTED CONTROL SYSTEM 9

. DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities

UNIT - IV INTERFACES IN DCS 9

Operator interfaces – Low level and high level operator interfaces – Displays – Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS .

UNIT - V ADVANCED TOPICS IN AUTOMATION 9

Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control– Case studies: PLC - SCADA - DCS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, 5th edition, 2019
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 2016

REFERENCES:

1.T.A. Hughes, Programmable Controllers, 4th edition, ISA press, 2005
2. Krishna Kant, Computer Based Industrial Control, Second revised edition, Prentice Hall of India, New Delhi, 2011.
3. John W. Webb and Ronald A. Reis, 'Programmable Logic Controllers, 1st edition, Pearson Education India, New Delhi, 2015.
4.Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st edition, 2004.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : LOGIC AND DISTRIBUTED CONTROL SYSTEM													Course Code : 20OE705		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
CO.1	Explain architecture & components of PLC												1	K2	1,2	1,2
CO.2	Explain building blocks of computer-controlled systems and SCADA												1	K2	1,2	1,2
CO.3	Explain various instructions used in PLC												2	K2	1,2	1,2
CO.4	Develop ladder programming for industrial sequential applications.												3	K3	1,2	1,2
CO.5	Explain various architectures of DCS												4	K2	1,2	1,2
CO.6	Discuss the application of automation tools in industries												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
CO.1	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.3	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.4	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.5	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.6	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	

20OE706	INDUSTRIAL COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communication ports
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

PRE-REQUISITE: NIL

UNIT-I DATA NETWORK FUNDAMENTALS 9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP

UNIT-II INTERNET WORKING and RS 232, RS485 9

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Device net

UNIT - III HART AND FIELD BUS 9

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

UNIT - IV MODBUS AND PROFIBUS PA/DP/FMS AND FF 9

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation -troubleshooting - review of foundation fieldbus - Data Highway

UNIT - V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 9

Industrial communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.strial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless

TOTAL: 45 PERIODS

TEXT BOOKS:

1.Behrouz Forouzan ,Data Communications & Networking ,5th edition, TMG,2017.
2. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier 1st edition, 2004

REFERENCES:

1.Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Pearson Education India 5th Edition. 2013.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Pearson Education India, 2nd Edition, 2010.
3. William Stallings, Wireless Communication & Networks, Practice, Pearson Education India, 2nd Edition, 2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INDUSTRIAL COMPUTER NETWORK													**Course Code : 20OE706**		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
CO.1	Explain the basic concepts of data communication and its importance.												1	K2	1,2	1,2
CO.2	Explain configurations of various internetworking devices												2	K2	1,2	1,2
CO.3	Explain the various communication protocols used in process industries.												3	K2	1,2	1,2
CO.4	Explain the architecture of field bus used in process industries.												3	K2	1,2	1,2
CO.5	Discuss the operation of various protocols & its applications.												4	K2	1,2	1,2
CO.6	Explain different Ethernet protocol and wireless communication networks used in Industrial process applications.												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
CO.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-	
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2		
CO.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2		
CO.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2		
CO.5	2	1	-	-	-	-	-	-	-	-	-	-	2	2		
CO.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2		

20OE707	MODERN ELECTRONIC INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on Electronic Instruments used in real life applications.
- To familiarize various types of oscilloscopes and analysers
- To understand the concepts and syntax for VI and to develop simple VI programs.
- To know about various telemetry systems

PRE-REQUISITE: NIL

UNIT-I ELECTRONIC INSTRUMENTS 9

Introduction to measurement system - Electronic Voltmeter and their advantages – Types, Differential amplifier, source follower, rectifier – True rms reading voltmeter – Electronic multimeter and ohmmeter – Current measurement – Power measurement - Q meter

UNIT-II CRO OSCILLOSCOPE & SIGNAL ANALYZERS 9

General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes– Analog and digital storage oscilloscope - frequency selective and heterodyne wave analyzer – Harmonic distortion analyzer – Spectrum analyzer.

UNIT - III VIRTUAL INSTRUMENTATION 9

Virtual instrumentation (VI) – Definition, flexibility – Block diagram and architecture of virtual instruments – Virtual instruments versus traditional instruments – Software in virtual Instrumentation - DAQ cards for VI applications –DAQ modules with serial communication

UNIT - IV VI PROGRAMMING 9

Concept of VIs and sub VI – Data types – Display types – Digital – Analog – Chart – Graphs- Oscilloscopic types – Loops – Case and sequence structures – Arrays and Cluster- Array function – Formulae nodes – Local and global variables.

UNIT - V TELEMETRY 9

General telemetry system – voltage, current and position telemetry systems – Radio frequency telemetry – Frequency modulation, pulse-amplitude modulation and pulse-code modulation telemetry – Frequency and time multiplexing

TOTAL: 45 PERIODS

TEXT BOOKS:

1. A.K. Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai & Co. (P) Limited, 2015.

2. Jovitha Jerome, “Virtual Instrumentation Using Labview”, PHI learning Pvt.Ltd,2010.

REFERENCES:

1. David A. Bell, “Electronic Instrumentation and measurements”, 2nd Edition, 2003
2. A.D.Helfrick, W.D.Coopper, “Modern Electronic Instrumentation & Measurement Techniques”, Prentice Hall of India, 2010.
3.Kalsi H.S, Electronic Instrumentation, 2nd Edition, Tata Mc Graw Hill Company, 2004
4. Sanjay Gupta, “Virtual Instrumentation using Lab view”, Tata McGraw-Hill Education,2010

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MODERN ELECTRONIC INSTRUMENTATION												**Course Code : 20OE707**			
CO	**Course Outcomes**											**Unit No**	**K-CO**	**POs**	**PSOs**
CO.1	Explain construction and working of Electronic Instruments											1	K2	1,2	1,2
CO.2	Discuss the working of various types of oscilloscopes and analysers											2	K2	1,2	1,2
CO.3	Explain the concepts of Virtual instrumentation											3	K2	1,2	1,2
CO.4	Explain DAQ system in VI											4	K2	1,2	1,2
CO.5	Develop simple VI programs in LabVIEW environment											4	K3	1,2,3,5,12	1,2
CO.6	Explain working principles of various telemetry systems											5	K2	1,2,10	1,2
CO-PO mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO.1	2	1	-	-	-	-	-	-	--	-	-	-	1	1	-
CO.2	2	1	-	-	-	-	-	-	--	-	-	-	1	1	-
CO.3	2	1	-	-	-	-	-	-	-	-	-	--	1	1	-
CO.4	2	1		-	-	-	-	-	-	-	-	-	1	1	-
CO.5	3	2	1	-	1	-	-	-	-	-	-	1	1	1	-
CO.6	2	1	-	-	-	-	-	-	--	1	-	-	1	1	-

20OE708 INSTRUMENTATION FOR AGRO FOOD INDUSTRY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explore scope of Instrumentation in agriculture field
- To know difference between continuous and batch process
- To Know greenhouse automation schemes
- To Understand sensors used in agriculture field.
- To Understand Instrumentation at weather monitoring stations

PRE-REQUISITE: NIL

UNIT-I INTRODUCTION **9**

Necessity of instrumentation & control for agriculture, engineering properties of soil: fundamental definitions & relationships, index properties of soil, permeability & seepage analysis, shear strength - Sensors: introduction to sonic anemometers, hygrometers, fine wire thermocouple

UNIT-II INSTRUMENTATION IN PROCESS INDUSTRY 9

Flow diagram of sugar plant & instrumentation set up for it, flow diagram of fermenter & control (batch process), flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up for it.

UNIT - III FOOD PROCESSING 9

Definition-Properties of foods and processing theory-Ambient Temperature Processing-Processing using electric fields, high hydrostatic pressure, light or ultra sound-Blanching – Heat sterilization- Dehydration- Baking and roasting – Chilling- Freezing – Post Processing operations- Coating- packing – filling and sealing of containers – Material handling.

UNIT - IV INSTRUMENTATION IN IRRIGATION AND GREEN HOUSE SYSTEM 9

Irrigation systems: necessity, irrigation methods: overhead, centre pivot, lateral move, micro irrigation systems, soil moisture measurement methods: resistance based method, voltage based method, thermal based method, Application of SCADA for DAM parameters & control. Green houses & instrumentation: ventilation, cooling & heating, wind speed, temperature & humidity, rain gauge carbon dioxide enrichment measurement & control.

UNIT - V INSTRUMENTS IN AGRICULTURE 9

Automation in earth moving equipments & farm equipments, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc. classification of pumps: pump characteristics, pump selection & installation. Agro metrological instrumentation weather stations, surface flux measurement, soil water content measurement.

TOTAL: 45 PERIODS

TEXT BOOKS:

1.B.C.Nakra and K.K.Chaudhary, “Instrumentation Measurement and Analysis”, Tata Mc Graw Hill , 2016.

2. P.Fellows, “ Food Processing Technology Principles and Practice,” 2nd edition, CRC press 2000

REFERENCES:

1. Bela G. Liptak , “Instrument Engineers' Handbook, Process Control and Optimization”, CRC Press; 4th edition, 2012.

2. Robert H. Brown, “ CRC Handbook of Engineering in Agriculture, Volume II: CRC Press; 1st edition, 1988.

3. D. Patranabis, "Principles of Industrial instrumentation" TMH,2010.

4. Michael. A.M, “ Irrigation : Theory and Practice” , Vikas Publishing House Pvt Ltd, 2nd edition 2008.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INSTRUMENTATION FOR AGRO FOOD INDUSTRY													**Course Code : 20OE708**		
CO	**Course Outcomes**												**Unit No**	**K-CO**	**POs**	**PSOs**
CO.1	Explain soil properties and sensors used for measurement.												1	K2	1,2	1,2
CO.2	Explain continuous and batch process.												2	K2	1,2	1,2
CO.3	Discuss various food Processing methods												3	K2	1,2	1,2
CO.4	Explain design aspects an automation scheme for green house.												4	K2	1,2	1,2
CO.5	Explain various irrigation methods.												4	K2	1,2	1,2
CO.6	Discuss the role of instrumentation in Agriculture												5	K2	1,2	1,2
CO-PO mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	
CO.1	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.3	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.4	2	1		-	-	-	-	-	-	-	-	-	1	1	-	
CO.5	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	
CO.6	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-	