FACULTY OF ENGINEERING

Scheme of Instructions and Examination

(AICTE Model Curriculum for the Academic Year 2020-21)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

in

Electronics and Instrumentation Engineering

(With effect from the academic year 2020 - 21)

(As approved in the faculty meeting held on XX-XX-2020)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

14.09.2021

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Electronics and Instrumentation Engineering) VII – SEMESTER

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration In Hrs	
Theory Courses										
1	PC443EE	Virtual Instrumentation	3	-	-	3	30	70	3	3
2	PC444EE	Opto-Electronic Instrumentation	3	-	-	3	30	70	3	3
3	PC445EE	Analytical Instrumentation	3	-	-	3	30	70	3	3
4	PE55_EE	Professional Elective - II	3	-	-	3	30	70	3	3
5	PE55_EE	Professional Elective - III	3	-	-	3	30	70	3	3
6	PE55_EE	Professional Elective - IV	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
7	PC464EE	Process Instrumentation Lab	-	-	2	2	25	50	3	1
8	PC467EE	Instrumentation Simulation Lab	-	-	2	2	25	50	3	1
9	PW702EE	Project Work Phase- I	-	-	6	6	25	50	-	3
10	PW701EE	Summer Internship*	-	-	-	-	50	-	-	1
Total			**18**	**-**	**10**	**28**	**305**	**570**	**-**	**24**

Professional Elective – II, III & IV		
1	PE553EE	Piping and Instrumentation Diagrams
2	PE554EE	Instrumentation in Aerospace and Navigation
3	PE555EE	Digital Control Systems
4	PE556EE	Automation in Process Control
5	PE557EE	Instrumentation and Control in Petrochemical Industry
6	PE558EE	Software Design Tools for Sensing and Control

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core PE: Professional Elective
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam) EE: Electrical Engg.

Note:

1. Each contact hour is a clock hour.
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
3. The students have to undergo a Summer Internship of six-week duration after VI–Semester and credit will be awarded in VII–Semester after evaluation.

Course Code	Course Title						Core / Elective
PC443EE	**Virtual Instrumentation**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce to the students about the interfacing techniques of various transducers.
- To expose the students to different signal conditioning circuits.
- To impart knowledge on the hardware required to build Virtual Instrument.
- To impart knowledge to build GUI for Virtual Instruments

Course Outcomes

By the end of this course, the students will be able to

1. Describe architect of VI
2. Program a virtual instrument
3. Interface the target transducer to the signal conditioning board.
4. Design a virtual instrument.
5. Apply the concept of virtual instrumentation to real time applications.

UNIT-I

Review of virtual Instrumentation: Historical Perspectives advantages block diagram and architecture of a virtual instrument, data –flow techniques graphical programming in data flow, comparison with conventional programming.

UNIT-II

VI programming Techniques: VIS and sub- VIS, loops and charts, array, clusters and graphs, case and sequence structures, formula nodes, local and global, variable, string and file I/O.

UNIT-III

Data Acquisition Basics: ADC, DAC, DIO, Counters & Timers, PC Hardware Structures, timing interrupts DMA, Software and hardware Installation.

UNIT IV

Common Instrument Interfaces: Current loop, RS232C/RS485, GPIB, Systems buses, Interface buses, USB, PCMCLA, VXI, SCXI, PXI etc. Networking basics for office & industrial application VISA and IVL.

UNITS –V

Application of VI with analysis Tools: Image acquisition and processing. Motion Control. Fourier transforms Power spectrum, correlation methods, and windowing& Filtering Vl applications in various fields.

Suggested Readings:

1. Gary Johnson, *Lab view Graphical Programming*, second edition, McGraw Hill, New York, 1997.
2. Lisa K., wells & Jeffrey Travis, *Lab View for Everyone*, Prentice Hall New Jersey 1997.
3. Sokoloff, *Basic Concepts of Lab View*, prentice Hall, New Jersey, 1998.
4. S. Gupta J.P. Gupta, *PC Interfacing for Data Acquisition & Process Control* 2nd edition,instrument Society of America, 1994.
5. Sanjay Gupta, *VI using Labview* 2E, McGraw Hill 2010.

Course Code	Course Title						Core / Elective
PC444EE	**Opto-Electronic Instrumentation**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To expose to the students on the basics of optical sources and detectors, optical fiber and fiber optic sensors.
- To impart knowledge on the characteristics of optical sources anddetectors.
- To introduce about the Industrial applications of fiber optic sensor andlaser

Course Outcomes

After completing this course, the student will be able to

1. Describe the properties, construction & classification of Lasers.
2. Explain operation & applications of Laser instrumen8ts with their safety measures.
3. Analyse operation & transmission in Optical fiber with their modulation techniques.
4. Express a fiber optic instrument to measure Electrical & Non-Electrical parameters.
5. Analyse various optoelectronic sensors and display devices

UNIT-I

Laser fundamentals: Mechanisms Properties of Laser Generations, Optical Feedback, And Classification of LASER: Solid, Liquid, Gas, Lasers and their Respective Enginery Level Diagrams. Construction of Dye, Nd-YAG, Argon and carbon dioxide lasers, Characteristics of stabilization Q- switching and mode locking.

UNIT-II

Laser Instruments: Laser interferometers, laser strain gauges, pulse echo technique, Beam modulation telemetry. Laser welding, Laser machining and Laser spectroscopy, Line shape function, lasing threshold, Application of lasers in Engineering and Medicine, safety with lasers.

UNIT- III

Optical fibers Fundamentals: Introduction to optical fibers, Fundamentals of Transmission theory, Fiber Fabrication and Manufacturing techniques, fiber Splicing, Connectors and Jointing Technique, Electro- Optic, Mechano - Optic and Acousto-optic Modulation techniques, Losses in Optical fibers.

UNIT-IV

Fiber Optic Instrumentation: Classification and Principle of fibers optic sensors. Optical time Domain Reflectometer. Multimode passive and active fibers sensors phase modulated sensors. Measurements of currents, Voltage, pressure, Temperature, Displacement, Acceleration, and Fluid level using optical fibers.

UNIT- V

Optoelectronic Devices and Components: Photo diodes, LDRs, PIN diodes, Solar cells, LED, S phototransistors LCD, plasma Display, Opt isolators, Photo Couplers.

Suggested Readings:

1. Wilson & J.F.B. Hawkers, *Optoelectronics- An Introduction* Prentice Hall of India 2nd Edtions
2. Amar K. Ganguly, *Optical & Opto Electronic Instrumentation*, Narosa Publishing House.
3. Shukbir Kumar Sarkar, *Optical Fibers and fiber Optics Instrumentation*, 2nd edition.S. Chand& Company
4. R.P. Khara *Fibre optics & Optical Commecam*

Course Code	Course Title						Core / Elective
PC445EE	**Analytical Instrumentation**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**1**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To make the students equipped about the analysis of materials as it is an important requirement of process control and quality control in industry.
- To expose the students to principles of various analytical methods.
- To impart the knowledge on various instruments used in the analysis of materials.

Course Outcomes

After completing this course, the student will be able to

1. Acquire knowledge of electromagnetic radiation with matter and apply analytical techniques.
2. Describe the relevance of material sampling and analysis in process control and quality control in industry.
3. Apply the knowledge of chromatography to separate the constituents from a complex mixture.
4. Identify the physical principles behind the various widely used analytical methods in the industry.
5. Select an appropriate analyser for an industrial requirement.

UNIT-I

Review of basic components of analytical instrumentation, Calorimeter and Spectrophotometers, Electromagnetic radiation, Beer –Lamberts Law, Absorption instruments, Calorimeters, Spectrophotometers sources of error and calibration.

UNIT-II

Infra –red Spectrophotometers infra-red Spectroscopy, Basic Components types of IR Spectrometry, sample handling techniques, FT-IR Spectroscopy, Calibration, Mass Spectrometers, Basic mass Spectrometer, types, Components, Resolution and application of Mass Spectroscopy.

UNIT-III

NMR, Principle of NMR Spectroscopy, Different types of NMR Spectrometers, Chromatography, Basic of Gas Chromatography, Methods of measurement of peak areas, Liquid chromatography, types of amino acid analysers.

UNIT-IV

Electro- Mechanical instruments, Electro-Chemical cell, Types of electrodes, potentiometers, conductivity meters, polar – graphs, PH-meters, Principle of measurements, Electrodes, Selective lon electrode, chemically sensitive semiconductor devices, Bio- Sensors.

UNIT-V

Industrial gas Analysers, Types, Para–magnetic Oxygen analyser, Magnetic wind instruments, Infra-red gas analyser, Thermal conductivity analyser, Analyser based on gas density, Methods based on ionization.
Environmental pollution monitoring instruments: Air pollution monitoring instruments, Co-$S0_2$ –No wet Chemical air analysis, Water pollution monitoring instruments.

Suggested Readings:

1. H.M Willard, L.L. Merit, J. A. Dean, *Instrumental Methods of Analy*sis CBS Publishers, Delhi.
2. R.S. Khandpur, *Analytical Instruments*, Tata McGraw Hills.

Course Code	Course Title						Core / Elective
PE553EE	**Piping and Instrumentation Diagrams (Professional Electives- II/ III/ IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Identify ISA symbols and interpret basic flow sheets layout principles.
- Exhibit comprehension of instrumentation/flow diagram relationships and flow sheet/plot plans/piping/ interrelationship.
- Prepare flow sheets (process and mechanical) diagrams and P&IDs.
- To provide knowledge on risk, hazard and their assessment techniques in Industry
- To provide knowledge on Safety in Instrumentation & Control Systems

Course Outcomes:

At the end of the course the students will be able to

1. Understanding of P&I Diagrams, standards involved and its preparation.
2. Awareness on the different fittings used for instruments installation and various softwares used for the preparation of P&IDs.
3. Understanding of Process safety, Safety Management Systems and instrumentation system design for hazardous applications.

UNIT – I

P&I Diagram objectives. Industry Codes and Standards. Government regulations, Engineering drawings: Block flow diagram (BFD), Process flow diagram (PFD), PFD symbols, Piping and instrumentation diagrams, P&ID symbols. Line numbering, Valve numbering, Equipment identification.

UNIT – II

Interpreting P&IDs – equipment: Valves, Vessels, Pumps, Heat exchangers, Compressors, Equipment labeling and identification, KKS numbering system, Smart P&IDs, Softwares used in preparation of P&IDs. Binary logic diagrams and Analog Loop diagrams for simple applications.

UNIT – III

Instrument connections: Pipe and pipe fittings, Flanged pipe fittings, Tape red thread pipe fittings, Parallel thread, pipe fittings, Sanitary pipe fittings, Tube and tube fittings, Compression tube fittings, Common tube fitting types and Bending instrument tubing, Instrument installation diagram.

UNIT – IV

Safety in Instrumentation & Control Systems: Hazardous Area & Material classification as per NEC Standards, Explosion Proof Housing, Encapsulation, Sealing, & Immersion, Purging systems. Intrinsic Safety: - Definition, Designing for intrinsic Safety, Isolation or Encapsulation (Series & Shunt Protective elements, & Zener barrier)

UNIT – V

Process safety and Safety Management Systems: Introduction to process safety, risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis (PHA), Hazard and operability study (HaZOp), Safety Integrity Level (SIL), Introduction to IEC61511 standard for Functional safety, protection layers, Safety Instrumented System: function, architecture, safety life cycle, Application of safety system

Suggested Reading:

1. Frederick, Meier and Clifford Meier, *Instrumentation and Control System Documentation,* ISA Publisher., 2nd Edition.
2. N.E. Bhttiha, *The Management Of Control System: Justification and Technical Auditing, ,* ISA.
3. Mannan S., *Lee's Loss Prevention in the Process Industries*, Vol.I, 3rdEd., ButterworthHeinemann, 2004.
4. Mannan S., *Lee's Loss Prevention in the Process Industries*, Vol.II & III, 3 rd Ed., ButterworthHeinemann, 2005.
5. Dave Macdonald, *Practical Industrial Safety, Risk Assessment and Shutdown Systems,* Elsevier, 2004.
6. American Society of Mechanical Engineers (ASME)

Course Code	Course Title						Core / Elective
PE554EE	**Instrumentation in Aerospace and Navigation (Professional Electives-II/ III/ IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- .To expose the students to the field of aerospace engineering
- To impart basic knowledge of its navigation instrumentation

Course Outcomes

At the end of the course students will be able to

1. To understand the basics of aerospace and navigation
2. To know the technical aspects of this subject
3. To know about various troubles in aircrafts

UNIT-I: Introduction to Aviation

History of aviation and space flight- anatomy of airplane and space vehicle with emphasis on control surfaces-airfoil nomenclature-basics of aerodynamics to illustrate lift and drag, types of drag, finite wings, swept wings, flaps-Airplane performance-thrust, power, rate of climb, absolute and service ceiling-range and endurance.

UNIT-II Aircraft Instrumentation

Basic engine instruments-capacitive fuel content-gauges, standard atmosphere, altimeters, aneroid-radio altimeters. Aircraft compass-remote indicating magnetic compass-rate of climb indicator-pilot static system-air speed indicator-mach meters-integrated flight instruments-flight testing-recording of flight tests.

UNIT-III- Radio Navigation Aids

Automatic direction finder-distance measuring equipments-instrument landing system- visual omni range-radar-optical instruments-engine instruments and control-pressure measurements-thermal meter control-tachometer-accelerometer-smoke and fire detection-propeller controls –twin blade control-cabin pressure and temperature.

UNIT-IV: Satellite and Space Vehicle Instrumentations

Satellite and space vehicle instrumentation-propulsion controls-sun sensors-horizon sensors-star tracker-stabilization controls

UNIT-V: Electrical Troubles

Hydraulic systems trouble-landing gear troubles-cabin conditioning troubles-indication of unsafe canopy-boeing condition-radio troubles-separate generator-system troubles-trouble indicator light-advantages of instrument flag-black box and its use.

Suggested Reading

1. John D Anderson JR, *Introduction to Flight*, Mc Graw Hill.
2. Pallett E.G.H, *Aircraft Instrumentation and Integrated Systems*‖, Longman scientific and Technical,1992
3. Nagaraja N.S, *Elements of Electronic Navigation*, Mc Graw Hill , New Delhi 1975

Course Code	Course Title						Core / Elective
PE555EE	**Digital Control Systems (Professional Electives-II/ III/ IV)**						**Elective**
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Control System	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To impart knowledge in the significance and features of design of discrete- time control system.
- To review on the different transform techniques for digital control system design.
- To impart knowledge on the techniques to analyse the system performance in the discrete-time domain.
- To impart knowledge in discrete state space controller design.

Course Outcomes

After completing this course, the student will be able to

1. Understand the various issues related to digital control systems such as effects of sampling and quantization, discrete time signals and models.
2. Represent a discrete-time control system using state space technique.
3. Design discrete control systems via pole placement.
4. Design observers for discrete control systems.
5. Analyse the stability of a discrete-time control system.

UNIT-I

Introduction to digital control Configuration of basic digital control system: discrete transfer function, discrete model sampled data systems using z- transform, transfer function model, signal analysis and dynamic response, zero-order hold equivalent, introduction to first-order-hold equivalent, transformation between splane, z-plane and w-plane, z-Domain description of sampled continuous-time systems. Controller design Controller Design using transform techniques: Root locus and frequency domain analysis compensator design.

UNIT-II

State space theory Control system analysis using state variable method: vector and matrices, state variable representation, conversion of state variable to transfer function and vice versa, conversion of transfer function to canonical state variable models, system realization, solution of state equations. Solution of discrete-time state equation. Computational methods.

UNIT-III

State space design using state-space methods: controllability and observability, control law design, pole placement, pole placement design using computer aided control system design (CACSD).

UNIT-IV

Observer design: Full order and reduced order discrete observer design - Kalman filter and extended Kalman filter design.

UNIT-V

Stability improvement by state feedback: Stability analysis and Jury‘s stability criterion, Lyapunov stability analysis to linear systems and discrete systems, Stability Improvement by state feedback.

Suggested Readings:

1. K. Ogata, *Discrete Time Control Systems*, Prentice Hall India, 2nd edition, 2005.
2. M. Gopal, *Digital Control and State Variable Methods*, Tata McGraw Hill, 3rd edition., 2008.
3. R. Isermann, *Digital Control Systems* Vol 1&2, Springer-Verlag, 1991
4. B. C. Kuo, *Digital Control System*, Oxford University Press, 2nd edition., 2007

Course Code	Course Title						Core / Elective
PE556EE	**Automation in Process Control (Professional Elective – II/ III/ IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

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

Course Outcomes

After completing this course, the student will be able to

1. Identify the automotive system and its components.
2. Apply the knowledge of various sensors and conditioning circuit in automotive systems.
3. Explain the various control strategies; the electronics and software used in automotive application.
4. Apply the knowledge of automation for describing real timesystems.
5. Describe the communication protocols used in industrialautomation.

UNIT-I

Data Acquisition and Control: Interfacing input signals, Digital signal conditioning, Output system with continuous actuators, Data acquisition and control using standard Add-on cards, pug-in cards, Input/ Output devices.

UNIT-II

SCADA: introduction to Supervisory Control and Data Acquisition (SCADA), Configuration of SCADA system, Remote Terminal Units, Typical Application as applied to process control systems

UNIT-III

DCS: Computers –Hierarchical control, DCS basics, Analog control, Direct Digital control, DCS Hardware Configuration, Software configuration, Displays: Groups displays, Overview display, Detail displays and Graphics displays. Local Control Units (LCU). DCS advantages over Mainframe Direct Digital Control. DCS P &ID symbols DCS integration with PLCS.

UNIT-IV

Examples of Experimental Computer Control of Processes: Computer Control of Liquid level system, Computer control of a heat exchanger, temperature control for plastic injection moulding processes, on line optimizing control of a Distillation column.

UNIT-V

Smart sensors and Field Bus: Smart sensors, Smart differential pressure transmitter, Smart temperature transmitter, Smart positioners for control valves, Advantages of smart sensors, Filed bus systems, HART protocol, Device description language, topology of field bus, industrial Field buses.

Suggested Readings:

1. Krishna Kant, *Computer Based Industrial Control*, Prentice Hall of India, 2001.
2. M.Chidambaram, *Computer Control of Processes*, Narosa Publishing Housem, New Delhi 2003
3. Bela.G. Liptak, *Instrument Engineers Handbook* 3rd edition Gulf Publications, 1995

Course Code	Course Title						Core / Elective
PE557EE	**Instrumentation and Control in Petrochemical Industry (Professional Elective – II/ III/ IV)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To provide a window of applications of instrumentation and automation in Petrochemical Industries.
- Additionally students know about the various methods in Petrochemical Industries and its control methods.

Course Outcomes:

At the end of the course the students will be able to

1. An understanding on various petrochemical process, important parameter to be monitored and controlled, various parameters to be analyzed and monitored.
2. Various instruments involved in and it‘s controlling process.
3. An ability to design and conduct experiments, as well as to analyze and interpret data.

UNIT – I

Brief survey of petroleum formation, petroleum exploration, Petroleum production, Petroleum refining and its methods, Refining capacity and consumption in India, constituents of Crude Oil, Recovery techniques – Oil – Gas separation, Processing wet gases.

UNIT – II

P & I diagram of petroleum refinery, Atmospheric distillation process, Vacuum distillation process, Thermal cracking, Catalytic cracking, Catalytic reforming, and Utility plants – Air, N2, and cooling water.

UNIT – III

Basics of field instruments, Parameters to be measured in Petrochemical industry, Distillation Column control, Selection of instruments, Basics of intrinsic safety of instruments, Area classification.

UNIT – IV

Control of furnace, Reboiler Control, Reflux Control, Control of catalytic crackers, Control of heat exchanger, Control of cooling tower.

UNIT – V

Basics of PLC, and Safety interlocks in furnace, separator, pump, and compressor. Basics of SIL, Introduction to Standards

Suggested Reading:

1. Waddams A.L, *Chemical from Petroleum*, Butter and Janner Ltd., 1968.
2. Balchan.J.G. and Mumme K.I., *Process Control Structures and Applications*, Van Nostrand Reinhold Company, New York, 1988.
3. Liptak B.G., *Instrument Engineers' Handbook*, Fourth Edition, CRC PRESS, 2003.
4. Austin G.T.Shreeves, *Chemical Process Industries*, McGraw Hill International student edition, singapore, 1985.

Course Code	Course Title						Core / Elective
PE559EE	**Software Design Tools for Sensing and Control ((Professional Elective – II/ III/ IV))**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To expose the students to the software tools available for sensor and control system design.
- To demonstrate the analytical and numerical modelling of various sensors in macro, meso and micro scale and to study its characteristics through simulation.
- To expose the students to modelling of physical systems, design and evaluation of various control methods.
- To expose the students to real time control implementation platforms and to practice on implementation of simple controllers.

Course Outcomes

After completing this course, the student will be able to

1. Select an appropriate software tools for sensor and actuator design.
2. Design model and simulate various sensing and actuating mechanisms.
3. Design controller and evaluate its performance through simulation
4. Design a controller using state space method and evaluate its performance through simulation.

UNIT-I

Course Content: Software tools for sensor design: Introduction to history of sensor design software tools, importance and need of software tools. Recent developments in sensor design and analysis software tools. Introduction to COMSOL Multiphysics, Structural Mechanics: Analysis of mechanical structures to static or dynamic loads. Stationary, transient, Eigen mode/modal, parametric, quasi-static and frequency-response analysis.

UNIT-II

Electrical: AC/DC Module for simulating electric, magnetic, and electromagnetic fields in static and low-frequency applications. Design and simulation of sensors and actuators using COMSOL. Software tools for micro sensor design: Introduction to IntelliSuite, mechanism design, development of sensors and actuators.

UNIT-III

Introduction to Coventorware: Description of main modules, Architect, Designer, Analyser and Integrator. System-level and physical-level design approaches. Introduction to meshing and result visualization. Design and simulation of sensors using Coventorware.

UNIT-IV

Software tools for control design: Introduction to MATLAB, Simulink and Scilab. Introduction to toolboxes. Control design problems using classical control. Control design problems using state space approach.

UNIT-V

Implementation of controllers in real time: Introduction to various hardware platforms, Control design and implementation for electrical/mechanical/electromechanical/chemical Processes using dSPACE, Lab VIEW and OPAL-RT.

Suggested Readings:

1. Roger W. Pryor, *Multiphysics Modeling Using COMSOL: A First Principles Approach*, Jones and Bartlett Publishers, 1st Edition, 2011.
2. Tamara Bechtold, Gabriela Schrag and Lihong Feng, *System-level Modeling of MEMS*, Wiley-VCH Verlag GmbH & Co, 1st Edition, 2013.
3. Holly Moore, *MATLAB for Engineers*, Pearson Education, 5th Edition, 2017.
4. Brian Hahn and Daniel Valentine, *Essential MATLAB for Engineers and Scientists*, Elsevier, Academic press, 6th edition.
5. Mehrzad Tabatabaian, *COMSOL 5 for Engineers, Mercury Learning & Information*, 1st Edition, 2015.
6. S R Otto and J P Denier, *An Introduction to Pro$_1$g$_0$ramming and Numerical Methods in MATLAB*, Springer-verlag, 1st Edition, 2005.

7. Stephen J Chapman, *MATLAB Programming for Engineers*, Bookware Companion Series, 5 th Edition, 2015.
8. Amos Gilat, *MATLAB – An Introduction with Applications*, John Wiley & Sons, Inc., 5th Edition, 2014.,

―Energy Management Handbook‖, Fairmont Pres, 5th Edition, 2004.

Course Code	Course Title						Core / Elective
PC464EE	**Process Instrumentation Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC442EE	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To experimentally verify the principle and characteristics of various controllers.
- To learn and understand the closed loop systems with various controller.

Course Outcomes

1. Explain the characteristics and significance of final control elements
2. Tune the controllers and improve the performance of the process
3. Implement control system using PLC in Process automation

List of Experiments:

1. Calibration of Current to Voltage and Voltage to Current Converter
2. Calibration of Current to Pressure and Pressure to Current Converters
3. Calibration of Temperature Control loop
4. Calibration of Pressure Control loop
5. Calibration of Flow Control loop
6. Calibration of Level Control loop
7. Application of PLC in Process Control
8. Tuning of Control Modes (P, PI, PID)
9. Study of Control Value Characteristics
10. Calibration of Pressure Gauge by using Dead Weight Tester
11. Application of Solenoid Valve in Process Control
12. Ratio Control System
13. Study of Interacting & Non-Interacting Systems
14. Calibration of Pneumatic Amplifier
15. Hydraulic logic Controllers – AND, OR, NOR, NAND Gates & Inverters
16. Measurement of Voltage, Temperature, Pressure & Flow using Hall Effect Sensors

Note: At least 10 experiments should be conducted in the semester

Suggested Readings:

1. G. Stephanopoulos, *Chemical Process Control-An Introduction to Theory and Practice*, Prentice Hall of India, New Delhi, 2nd Edition, 2005.
2. D.R. Coughanowr, *Process Systems Analysis and Control*, McGraw Hill, Singapore, 2nd Edition, 1991.
3. B.W. Bequette, *Process Control Modeling, Design and Simulation*, Prentice Hall of India

Course Code	Course Title						Core / Elective
PC467EE	**Instrumentation Simulation Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To familiarize the students with different signal conditioning circuits for temperature and pressure measuring transducer.
- To familiarize the students to the calibration practices used in industries.
- To impart knowledge in the transmitter design.

Course Outcomes

After completing this course, the student will be able to

1. Simulate Electrical systems using software tools.
2. Design and simulate compensators.
3. Simulate the control system for temperature, level and pressure measurement systems.
4. Analyse ECG waveform with VI.
5. Simulate digital communication system with VI.

List of Experiments:

1. Verification of Network theorems (i) Thevenin's theorem (ii) Superposition theorem (iii) Maximumpower transfer theorem.
2. Transient responses of series RLC, RL and IRC circuits with Sine and Step inputs.
3. Series and Parallel resonance.
4. Bode Plot, Root-Locus plot and Nyquist plot.
5. Transfer function analysis (i) Time Response for Step input (ii) Frequency response for Sinusoidalinput.
6. Design of Lag, Lead and Lag-Lead Compensators.
7. Design & Simulation of pressure Monitoring System Using lab view.
8. Simulation of tank Level Control system using Lab View
9. Analysis of an ECG Waveform Using Lab View.
10. Design of Temperature Monitoring System Using Lab view.
11. Simulation of Transmission &Reception of Digital Data Using Lab View.

Note: At least ten Experiments should be completed in the Semester.

Suggested Readings:

1. Doebelin E.O, *Measurement Systems: Application and Design*, McGraw Hill, 5th Edition, 2004.
2. Patranabis D, *Principles of Industrial Instrumentation*, Tata McGraw Hill, 3rd Edition, 2010.
3. Roy D. Choudary and Shail Jain, *Linear Integrated Circuits*, New Age International, 2010.

Course Code	Course Title						Core / Elective
PW702EE	**Project Work Phase – I**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**6**	**25**	**50**	**3**

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The department can initiate the project allotment procedure at the end of VI semester and finalize it in the first two weeks of VII semester.
The department will appoint a project coordinator who will coordinate the following:
Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
Grouping of students (max 3 in a group)
Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To get awareness on current problems and solution techniques, the first 4 weeks of VII semester will be spent on special lectures by faculty members, research scholars, post graduate students of the department and invited lectures by engineers from industries and R&D institutions. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide.
Seminar schedule will be prepared by the coordinator for all the students from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:

1. Submit a one-page synopsis before the seminar for display on notice board.
2. Give a 30 minutes ‘presentation followed by 10 minutes ‘discussion.
3. Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.
The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.

SCHEME OF INSTRUCTION & EXAMINATION
B.E. (Electronics and Instrumentation Engineering) VIII – SEMESTER

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hrs/Wk	CIE	SEE	Duration In Hrs	
Theory Courses										
1	PE56_EE	Professional Elective – V	3	-	-	3	30	70	3	3
2	PE56_EE	Professional Elective –VI	3	-	-	3	30	70	3	3
3	OE6_EE	Open Elective-III	3	-	-	3	30	70	3	3
Practical / Laboratory Courses										
4	PW703EE	Project Work Phase-II	-	-	16	16	50	100	-	8
Total			**09**	**-**	**16**	**25**	**140**	**310**	**-**	**17**

Professional Elective – V & VI		
1	PE560EE	Neural Networks and Fuzzy Logic
2	PE561EE	Instrumentation for Agricultural and Food Processing Industries
3	PE562EE	Digital Image Processing
4	PE563EE	Power Plant Design and Safety Management
5	PE564EE	Advanced Programmable Logic Controller

Open Elective – III		
1	OE605EE	Smart Building Systems (Not for EEE & EIE Students)
2	OE606EE	Programmable Logic Controllers (Not for EEE & EIE Students)
3	OE631AE	Automotive maintenance (Not for Mech./Prod./Auto. Engg. students)
4	OE631ME	Mechatronics (Not for Mech./Prod./Auto. Engg. students)
5	OE821CE	Road Safety Engineering (Not for Civil Engg. Students)
6	OE822IT	Software Engineering (Not for IT Students)

HS: Humanities and Social Sciences BS: Basic Science ES: Engineering Science
MC: Mandatory Course PC: Professional Core PE: Professional Elective
L: Lecture T: Tutorial P: Practical D: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Evaluation (Univ. Exam) EE: Electrical Engg.

Note:

1. Each contact hour is a clock hour.
2. The duration of the practical class is two hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

Course Code	Course Title						Core / Elective
PE560EE	**Neural Networks and Fuzzy Logic (Professional Elective – V / VI)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To make the student familiar with the concepts of

- Explain the concepts of neural networks, fuzzy logic, and genetic algorithms.
- Solve problems that are appropriately solved by neural networks, fuzzy logic, and genetic algorithms.
- Understand the structure of expert systems.

Course Outcomes

After completing this course, the student will be able to

1. Describe with the basic concepts of Neural Network and Fuzzy logic.
2. Explain different types of Neural Network
3. Develop Neural Network based modelling and control for different process applications.
4. Explain fuzzy mathematics.
5. Design Fuzzy logic based control system for process applications.

UNIT-I

Introduction to fuzzy logic and neural networks, Classification, Merits and demerits of intelligent techniques compared to conventional techniques. Need of an intelligent techniques for real world Engineering applications.

UNIT-II

Supervised and Unsupervised Neural networks: Perceptron, Standard back propagation Neural network: Architecture, Algorithm and other issues. Discrete Hopfield's networks, Kohnen's self-organizing maps, adaptive resonance theory

UNIT-III

Neural networks for control systems: Schemes of Neuro-control, identification and control of dynamical systems, case studies.

UNIT-IV

Fuzzy set and operations, Fuzzy relations, Fuzzifications, Fuzzy rule based systems, defuzzification fuzzy learning algorithms.

UNIT-V

Fuzzy logic for control system with case studies. Introduction to neuro-fuzzy system and genetic algorithm.

Suggested Readings:

1. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, John Wiley & Sons, 3rd Edition, 2010.
2. Laurene Fausett, *Fundamentals of Neural Networks*, Pearson education, Eight Impression, 2012.
3. S. Haykin, Neural Networks: A comprehensive Foundation, Prentice Hall Inc., New Jersey, 2nd Edition,
4. 1999.
5. Klir G.J and Folger T.A, *Fuzzy Sets, Uncertainty and Information*, Prentice Hall, New Delhi, 1994.
6. Zdenko Kovacic, Stjepan Bogdan, *Fuzzy Controller Design Theory and Applications*, CRC Press, 1st edition, 2006.
7. Satish Kumar, *Neural Networks–A Classroom Approach*, Tata McGraw-Hill, 2013.

Course Code	Course Title						Core / Elective
PE561EE	**Instrumentation for Agricultural and Food Processing Industries (Professional Elective – V / VI)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To make the student familiar with the concepts of

- Problems and possible technological solution of agro industries.
- To Familiarize with current literature, research in agricultural instrumentation
- To analyze and design of automation system by evaluating agricultural parameter measurement constraint.

Course Outcomes

After completing this course, the student will be able to

1. Understand the necessity of instrumentation in agriculture and food processing.
2. Familiarized with instrumentation requirement in agriculture and food processing.
3. Analyse and design systems/instruments for agriculture and food processing.
4. Understand problems in agriculture and food processing and provide technological solution to the same.

UNIT-I

Introduction: Necessity of instrumentation and control for food processing and agriculture sensor requirement, remote sensing, biosensors in Agriculture, standards for food quality.

UNIT-II

Instrumentation for food quality assurance: Instrumental measurements and sensory parameters. Inline measurement for the control of food processing operations: color measurements of food, food composition analysis using infrared, microwave measurements of product variables, pressure and temperature measurement in food process control, level and flow measurement in food process control, ultrasonic instrumentation in food industry. Instrumental techniques in the quality control.

UNIT-III

Major Processes: Flow diagram of sugar plant, sensors and instrumentation set-up for it, Oil extraction plant and instrumentation set-up, Juice extraction control set-up.

Instrumentation for Agriculture: Irrigation systems: necessity, irrigation methods: overhead, centre pivot, lateral move, micro irrigation systems & it‘s performance, comparison of different irrigation systems, soil moisture measurement methods.

UNIT-IV

Major Processes: Application of SCADA for DAM parameters and control, Water distribution and management control, Auto-Drip irrigation systems, Irrigation Canal management, upstream and downstream control concepts, supervisory control.

Green houses and Instrumentation: Ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control.

UNIT-V

Design considerations of agricultural and food Processing Equipments: Design of Food Processing equipments, dryers, design of dryers PHTC, RPEC, LSU and Drum Dryer, determination of heat and air requirement for drying grains.

Suggested Readings:

1. Erika Kress-Rogers and Christopher J. B. Brimelow‖ Instrumentation and sensors for the food industry**”** Woodhead Publishing, CRC Press.

2. P.J. Fellows, Food Processing Technology Principles and Practice, Woodhead Publishing, 3rd Edition, 2009.
3. Semioh Otles, Methods of analysis of food components and additives, CRC Press,Taylor and Francis group, 2nd Edition, 2012.
4. Sahu J. K., Fundamentals of Food Process Engineering, Alpha Science Intl Ltd, 2016.
5. Mcmillan G..K., Considine D. M .,Process/Industrial Instruments and Controls Handbook, McGraw Hill International, 5th edition,1999.
6. Liptak B. G., Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II, CRC press, 4th Edition,2005.
7. Hall C. W., Olsen W. C.,The literature of Agriculture Engineering, Cornell University Press, 1992.

Course Code	Course Title						Core / Elective
PE562EE	**Digital Image Processing (Professional Elective – V / VI)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To make the student familiar with the concepts of

- To provide background and fundamental material for the analysis and processing of digital signals.
- To familiarize the relationships between continuous-time and discrete time signals and systems.
- The impetus is to introduce a few real-world signal processing applications.

Course Outcomes

After completing this course, the student will be able to

1. Explain image formation and the role human visual system plays in perception of gray and color image data.
2. Apply image processing techniques in both the spatial and frequency (Fourier) domains.
3. Design image analysis techniques in the form of image segmentation and to evaluate the Methodologies for segmentation.
4. Conduct independent study and analysis of Image Enhancement techniques.

UNIT-I

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

UNIT-II

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.

UNIT-III

Restoration: Noise models, Restoration in the Presence of Noise only using Spatial Filtering and Frequency Domain Filtering, Linear, Position Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

UNIT-IV

Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. Wavelets: Background, Multi resolution Expansions. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

UNIT-V

Segmentation: Point, Line, and Edge Detection, Thresholding, Region Based Segmentation, Segmentation Using Morphological Watersheds.

Representation and Description: Representation, Boundary descriptors.

Suggested Readings:

1. Rafel C Gonzalez and Richard E. Woods, *Digital Image Processing*, PHI 3rd Edition 2001.
2. S.Jayaraman, S.Esakkirajan, T.Veerakumar, *Digital Image Processing*, Tata McGraw Hill 2014.
3. A. K. Jain, *Fundamentals of Digital Image Processing*, Pearson 2004.

Course Code	Course Title						Core / Elective
PE563EE	**Power Plant Design and Safety Management (Professional Elective – V / VI)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To make the student familiar with the concepts of

- To acquire good knowledge of process and its management strategies.
- To acquire good knowledge of process documentation and its safety related issues.
- To understand the basics of security issues of various process plants.

Course Outcomes

After completing this course, the student will be able to

1. Model conceptual and methodological framework for describing a process and its management strategies
2. Learn effective documentation and auditing techniques for I & C plants
3. Learn the art of selecting safe zones for setting up of process control plants
4. Apply the process safety management tools and techniques in real time projects and plants
5. Emphasis on security aspects like network security control centre and work station design and its related security

UNIT-I

Overall plant design: Auditing existing plants for updating, project management and documentation, operator training, commissioning and start up, historical data storage and evaluation, Integration of process data with maintenance systems.

UNIT-II

Designing a Safe Plant: Hazardous area classification: Division classification and zone classification systems, Intrinsic safety rules for field bus installations: Intrinsic safety, Entity concept, Field bus intrinsically safe concept with examples, purging and inerting systems: Types of purge systems, Purge flow regulators.

UNIT-III

Process Safety Management: Elements of process safety management, Process hazard analysis, The HAZOP concept, Training with documentation, Incident analysis and reports, Emergency response plan, Issues in protective system technology, High integrity pressure protection system: code requirements and standards, HIPPS justification, device integrity architecture.

UNIT-IV

Network Security: Physical security, security policies, encrypt to protect network data, operating system security, login and password security, protection from viruses, digital certificates, securing the network with fire walls, Intelligent alarm management.

UNIT-V

Control Centre and Work Station Design: Operator interface evolution, Virtual reality tools for testing control room concepts, upgrading the control room, manufacturing platforms and work stations, workstation hosts: design concepts and classification.

Suggested Readings:

1. B.G. Liptak, *Instrument Engineers Handbook*, Fourth Edition, Three Volume Set, 2012.
2. Béla G. Lipták and Halit Eren, *Instrument Engineers' Handbook: Process Software and Digital Networks* (ISA Edition). 2011.

Course Code	Course Title						Core / Elective
PE564EE	**Advanced Programmable Logic Controller (Professional Elective – V / VI)**						**Elective**
	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To acquire good knowledge of industrial automation.To acquire good knowledge of PLC programming.

To know the basics of networking of PLC.

Course Outcomes

After completing this course, the student will be able to

1. Describe the architecture of PLC and differentiate between legal & illegal PLC ladder programminglayouts.
2. Create Ladder diagram from a sequence of operational steps using Timers and counters with the '9'planning steps.
3. List and define the six basic intermediate functions.
4. Describe and apply the PLC MOVE/JUMP function to industrial problems in combination with otherPLCs Data Handling functions.
5. Covert input signal to a form usable by input modules and output module to a form usable for output devices.

UNIT-I

PLC Basics: Definition and History of PLC- PLC advantages and disadvantages – Over all PLC Systems –CPUs and Programmer/Monitors –PLC input and output models– Printing PLC Information Programming Procedures –Programming Equipment – Programming Formats – Proper Construction of PLC Diagrams – Devices to which PLC input and output modules are connected – Input on/off Switching devices – Input analog devices – Output analog on/off devices and output analog devices.

UNIT-II

Basic PLC Programming and Basic PLC Functions: Programming on/off inputs to produce on/off outputs- PLC input instructions – Out puts – Operational procedures– Contact and coil input/output programming examples- Relation of digital gate logic contact/coil logic – PLC programming and conversionexamples – creating ladder diagrams from process control descriptions – Sequence listings – Large process ladder diagram constructions. General Characteristics of Registers – Module addressing – Holding registers

– Input registers – PLC timer functions – examples of timer functions. Industrial applications – PLC counterfunctions.

UNIT-III

Intermediate Functions: PLC Arithmetic functions – PLC additions and subtractions– The PLC repetitive clock – PLC Multiplications, Division and Square Root – PLC trigonometric and Log functions- Other PLC Arithmetic Functions – PLC number comparison functions – PLC basic comparison functions and applications – Numbering systems and number conversion functions – PLC conversion between decimal BCD – Hexadecimals numbering systems.

UNIT-IV

Data Handling Functions: The PLC skip and master control relay functions – Jump functions – Jump with non-return – Jump with return PLC data move Systems – The PLC functions and applications – PLC functions working with bits – PLC digital bit functions and applications – PLC Sequence functions – PLC matrix functions.

UNIT-V

Advanced PLC Functions: Analog PLC Operation: Types of PLC analog modules & Systems – PLC Analog Signal Processing - PID Control of Continuous Processes - Networking PLCs

Suggested Readings:

1. John W. Weff, Ronald A Reis, *Programmable Logic Controllers,* Prentice Hall of India Private Limited, Fifth edition, 2003.

Course Code	Course Title						Core / Elective
OE605EE	**Smart Building Systems (Open Elective-III)**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the basic blocks of Building Management System.
- To design various sub systems (or modular system) of building automation
- To integrate all the sub systems

Course Outcomes

At the end of the course students will be able to

1. Describe the basic blocks and systems for building automation
2. Use different subsystems for building automation and integrate them.
3. Understand basic blocks and systems for building automation
4. Design different systems for building automation and integrate those systems

UNIT-I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT-II

Fire Alarm (FA) System: concept of fire, Fire modes, History, Components, and Principles of Operation. Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. Types of FAS Architectures, Examples. Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT-III

Access Control System: Access Components, Access control system Design.

CCTV: Camera Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. CCTV Applications.

UNIT-IV

Security Systems Fundamentals: Introduction to Security Systems, Concepts.

Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security system design for verticals. concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control –DAC, MAC, RBAC.

EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT-V

Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.

Building Management System: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS, Advantages & Applications of BMS, IBMS Architecture, Normal & Emergency operation, Advantages of BMS.

Suggested Reading:

1. Jim Sinopoli, *Smart Buildings*, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Reinhold A. Carlson, Robert A. Di Giandomenico, *Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs)*, R.S. Means Company Publishing, 1991.
3. Albert Ting-Pat So, WaiLok Chan, Kluwer , *Intelligent Building Systems*, Academic publisher,3rd ed., 2012.
4. Robert Gagnon, *Design of Special Hazards and Fire Alarm Systems*, Thomson Delmar Learning; 2nd edition, 2007.
5. Levenhagen, John I.Spethmann, Donald H, *HVAC Controls and Systems*, McGraw-Hill Pub.
6. Hordeski, Michael F, *HVAC Control in the New Millennium*, Fairmont press, 2001.
7. Bela G. Liptak, *Process Control-Instrument Engineers Handbook*, Chilton book co.

Course Code	Course Title						Core / Elective
OE606EE	**Programmable Logic Controllers (Open Elective-III)**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To be able to understand basics of Programmable logic controllers, basic programming of PLC.
- To make the students to understand the Functions and applications of PLC

Course Outcomes

At the end of the course students will be able to

1. Develop PLC programs for industrial applications.
2. Acquire the knowledge of PLC counter functions and PLC Arithmetic functions and data handling functions.

UNIT-I

PLC Basics: Definition and History of PLC - PLC advantages and disadvantages - Over all PLC Systems - CPUs and Programmer Monitors - PLC input and output models - Printing PLC Information- Programming Procedures - Programming Equipment - Programming Formats- Proper Construction of PLC Diagrams - Devices to which PLC input and output modules are connected - Input on/off switching devices - Input analog devices - Output analog on/off devices and output analog devices.

UNIT-II

Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - Operational procedures - Contact and coil input/output programming examples - Relation of digital gate logic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from process control descriptions - Sequence listings - Large process ladder diagram constructions.

UNIT-III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions - examples of timer functions. Industrial applications - PLC counter functions.

UNIT-IV

Intermediate Functions: PLC Arithmetic functions - PLC additions and subtractions - The PLC repetitive clock - PLC Multiplications, Division and Square Root - PLC trigonometric and log functions - Other PLC arithmetic functions - PLC number comparison functions. PLC basic comparison functions and applications - Numbering systems and number conversion functions - PLC conversion between decimal and BCD-Hexadecimals numbering systems.

UNIT-V

Data Handling Functions: The PLC skip and master control relay functions - Jump functions - Jump with non return - Jump with return. PLC data move Systems - The PLC functions and applications. PLC functions working with bits - PLC digital bit functions and applications - PLC sequence functions - PLC matrix functions.

Suggested Reading:

1. John W. Weff, Ronald A. Reis, Programmable Logic Controllers, Prentice Hall of India Private Limited, Fifth edition, 2003.
2. Frank D. Petruzella, *Programmable Logic Controllers*, 5th Edition, Mc-Graw Hill, 2019.

AUTOMOTIVE MAINTENANCE

OE 631 AE

Instruction: 3 periods per week *Duration of SEE: 3 hours*
*CIE: 30 *marks* *SEE: 70 marks*
Credits: 3

Objectives:

1. To study basic types of vehicle maintenance along with its importance
2. To understand the trouble diagnosis procedure for electrical and electronic systems in automobiles
3. To acquaint with various Trouble shooting, fault tracing practices available in automobile industry
4. To understand the maintenance procedure for air-conditioning in automobiles.

Outcomes:

Student will be able to

1. Demonstrate the maintenance procedure for automotive Engine.
2. Illustrate the trouble diagnosis procedure for electrical systems like Battery, Starting Systems
3. Identify the trouble diagnosis procedure for steering and suspension system
4. Illustrate trouble diagnosis procedure for lubrication and fuel delivery system etc.
5. Explain trouble diagnosis procedure for heating system of automobile.

UNIT – I

Maintenance, Workshop Practices, Safety and Tools: Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis.
vehicles, fire safety - First aid. Basic tools –Scheduled maintenance services – service intervals - Towing and recovering.

UNIT – II

Engine and Engine Subsystem Maintenance: introduction engine IC Engine General Engine service-cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management. **S**ervice - fault diagnosis- servicing emission controls.

UNIT – III

Transmission and Driveline Maintenance: Clutch- general checks, adjustment and service- road testing, Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

UNIT – IV

Steering, Brake, Suspension and Wheel Maintenance: *Inspection*, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage.

UNIT – V

***Auto Electrical and Air Conditioning Maintenance*:** Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Suggested Readings:

1. Ed May, "*Automotive Mechanics Volume One*‖, McGraw Hill Publications, 2003.
2. Ed May, "*Automotive Mechanics Volume Two*‖, McGraw Hill Publications, 2003
3. *Vehicle Service Manuals of reputed manufacturers*
4. *Bosch Automotive Handbook*, Sixth Edition, 2004

MECHATRONICS

OE 631 ME

Instruction: 3 periods per week *Duration of SEE: 3 hours*
*CIE: 30 *marks* *SEE: 70 marks*
Credits: 3

Objectives:

Student has to understand the

1. How to identify, formulate, and solve engineering problems
2. The design a system, component, or process to meet desired needs within realistic constraints
3. The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
4. The use of drive mechanisms and fluid power systems
5. The use of industrial electronic devices
6. The demonstrate the design of modern CNC machines, and Mechatronics elements

Outcomes:

At the end of the course, the students will be able to

1. Model and analyse electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of Mechatronics systems
3. Do the complete design, building, interfacing and actuation of a Mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various Mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and Mechatronics elements

Unit-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

Unit-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

Unit-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro pneumatic circuits

Unit-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to microprocessor & micro controller, Temperature measurement interface and LVDT interface, Systems response

Unit-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Suggested Reading:

1. William Bolton, Mechatronics: Electronic control systems in mechanical and electrical

engineering, 6th edition, Pearson Education
2. HMT Ltd, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998
3. Michaels Histand & David G, Alciatore, Introduction to Mechatronics and Measurement Systems, Tata McGraw-Hill International Edition
4. Devdas Shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning
5. S.R. Majumdar, Oil Hydraulic Systems – Principles & Maintenance, McGraw-Hill Publishing Company Limited, New Delhi
6. Godfrey Onwubolu, Mechatronics: Principles and Applications, Butterworth-Heinemann

ROAD SAFETY ENGINEERING

OE 821 CE

Instruction: 3 periods per week *Duration of SEE: 3 hours*
*CIE: 30 *marks* *SEE: 70 marks*
Credits: 3

Objectives:

1. Introduction to various factors considered for road safety and management
2. Explain the road safety appurtenances and design elements
3. Discuss the various traffic management techniques

Outcomes:

Student will be able to

1. Understand the fundamentals of traffic safety analysis
2. Analyze Accident data
3. Remember the concepts of road safety in urban transport
4. Apply crash reduction techniques
5. Design of urban Infrastructure considering safety aspects.

UNIT – I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering - Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons.

UNIT – II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT – III

Road Safety in planning and Geometric Design: Vehicle And Human Characteristics, Road Design and Road Equipment‘s, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.

UNIT – IV

***Traffic Signals & Road signs*:** Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMT Vehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Signs and Pavement Markings.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT – V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

Suggested Readings:

1. Kadiyali L.R,. *Traffic Engineering and Transport planning*, 9th Edition, Khanna Tech Publishers,

2013.
2. C.E.G. Justo, A. Veeraragavan and S. K. Khanna, *Highway Engineering*, 10th Edition, Nem Chand Publishers, 2017.
3. Donald Drew, *Traffic Flow Theory Chapter 14 in Differential Equation Models*, Springer, 1983
4. C. Jotinkhisty and B. Kent Lall, *Transportation Engineering – An Introduction, 3rd Edition, Pearson publications, 2017*
5. Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson, *Handbook of Road Safety measures, second Edition, Emerald Publishing, 2009.*
6. Highway Research Programme (NCHRP) Synthesis 336.*A synthesis of Highway Research Board, Washington D.C, 2016.*

SOFTWARE ENGINEERING

OE 822 IT

Instruction: 3 periods per week *Duration of SEE: 3 hours*
*CIE: 30 *marks* *SEE: 70 marks*
Credits: 3

Objectives:

1. To introduce the basic concepts of software development processes from defining a product to shipping and maintaining
2. To impart knowledge on various phases, methodologies and practices of software development
3. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics

Outcomes:

Student will be able to

1. Acquired working knowledge of alternative approaches and techniques for each phase of software development
2. Judge an appropriate process model(s) assessing software project attributes and analyze necessary requirements for project development eventually composing SRS.
3. Creation of visual models to describe (non-) algorithmic solutions for projects using various design principles.
4. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting knowledge on patterns.

UNIT – I

Introduction to Software Engineering:

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT – II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT – III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT – IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Modeling Component-Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT – V

Testing: Strategies: A Strategic Approach to Conventional Software Testing, Test Strategies for O-O Software.

Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods.

Debugging: Debugging Techniques, The Art of Debugging.

Product Metrics: A Framework for Product Metrics, Metrics for each phase of software development.

Software Quality: Definition, ***Quality Assurance:*** Basic Elements, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO9000 Quality Standards, SQA Plan.

Suggested Readings:

1. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, 7th Edition, McGraw Hill, 2009
2. Ali Behforooz and Frederick J. Hudson, *Software Engineering Fundamentals*, Oxford University Press, 1996
3. Pankaj Jalote, *An Integrated Approach to Software Engineering*, 3rd Edition, Narosa Publishing House, 2008

Course Code	Course Title						Core / Elective
PW703EE	**Project Work Phase - II**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	**16**	**50**	**100**	**8**

Course Objectives

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes

1. Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to the real-world problems.
2. Evaluate different solutions based on economic and technical feasibility
3. Effectively plan a project and confidently perform all aspects of project management
4. Demonstrate effective written and oral communication skills

The aim of Project work– Phase II is to implement and evaluate the proposal made as part of Project Work - Phase I. Students can also be encouraged to do full time internship as part of project work-II based on the common guidelines for all the departments. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

The department will appoint a project coordinator who will coordinate the following:

1. Re-grouping of students - deletion of internship candidates from groups made as part of project Work-Phase I
2. Re-Allotment of internship students to project guides
3. Project monitoring at regular intervals

All re-grouping/re-allotment has to be completed by the 1st week of VIII semester so that students get sufficient time for completion of the project.

All projects (internship and departmental) will be monitored at least twice in a semester through student presentation for the award of sessional marks. Sessional marks are awarded by a monitoring committee comprising of faculty members as well as by the supervisor. The first review of projects for25 marks can be conducted after completion of five weeks. The second review for another 25 marks can be conducted after 12 weeks of instruction.

Common norms will be established for the final documentation of the project report by the respective departments. The students are required to submit draft copies of their project report within one week after completion of instruction.

Note: Three periods of contact load will be assigned to each project guide.

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