FACULTY OF ENGINEERING

Scheme of Instruction & Examination

(CBCS Curriculum for the Academic Year 2019-2020)

and

Syllabi

B.E. VII and VIII Semester

of

Four Year Degree Programme

In

Electronics and Instrumentation Engineering

(With effect from the academic year 2019– 2020)

(As approved in the faculty meeting held on 25-06-2019)

Issued by

Dean, Faculty of Engineering

Osmania University, Hyderabad – 500 007

2019

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII - Semester
(ELECTRONICS AND INSTRUMENTATION ENGINEERING)

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	**PC 711 EE**	Opto-Electronic Instrumentation	3	-	-	3	30	70	3	3
2	**PC 712 EE**	Virtual Instrumentation	3	-	-	3	30	70	3	3
3	**PC 713 EE**	Analytical Instrumentation	3	-	-	3	30	70	3	3
4		Open Elective – II	3	-	-	3	30	70	3	3
5		Open Elective – III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
6	**PC 752 EE**	Microprocessor and Microcontrollers Lab	-	-	2	2	25	50	3	1
7	**PC 753 EE**	Instrumentation Simulation Lab	-	-	2	2	25	50	3	1
8	**PW 761 EE**	Summer Internship	-	-	4	4	50	-	-	2
9	**SI 762 EE**	Project Work – I	`	-	-	-	50	-	-	2
			15	**-**	**08**	**23**	**300**	**450**		**21**

Open Elective – II			**Open Elective – III**		
S. No.	Course Code	Course Title	S. No.	Course Code	Course Title
1	**OE 771 CE**	Green Building Technologies	1	**OE 781 CE**	Road Safety Engineering
2	**OE 772 CS**	Data Science Using R Programming	2	**OE 782 IT**	Software Engineering
3	**OE 773 EC**	Fundamentals of IoT	3	**OE 783 EC**	Principles of Electronic Communications
4	**OE 774 EE****	Non-Conventional Energy Sources	4	**OE 784 EE****	Illumination and Electric Traction systems
5	**OE 775 ME**	Entrepreneurship	5	**OE 785 ME**	Mechatronics

PC: Professional Course PE: Professional Elective
L: Lectures T: Tutorials P: Practical D: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

Note-2: * The students have to undergo a Summer Internship of four weeks' duration after VI semester and credits will be awarded in VII semester after evaluation.
** Subject is not offered to the students of EEE and EIE Department.

Course Code	Course Title						Core / Elective
PC 711 EE	**Opto-Electronic Instrumentation**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 507 EE	**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 and detectors.
- To introduce about the Industrial applications of fiber optic sensor and laser

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 instruments 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
PC 712 EE	**Virtual Instrumentation**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 507 EE	**3**	**1**	**-**	**-**	**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. 4, 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
PC 713 EE	**Analytical Instrumentation**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 507 EE	**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 Analysis CBS
2. Publishers, Delhi.
3. R.S. Khandpur, Analytical instruments, Tata McGraw Hills1989.

Course Code	Course Title						Core / Elective
OE 771 CE	**Green Building Technologies**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To impart knowledge of the principles behind the green building technologies.
- To know the importance of sustainable use of natural resources and energy.
- To understand the principles of effective energy and resources management in buildings.
- To bring awareness of the basic criteria in the green building rating systems.
- To understand the methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes

After completing this course, the student will be able to

1. Define a green building, along with its features, benefits and rating systems.
2. Describe the criteria used for site selection and water efficiency methods.
3. Explain the energy efficiency terms and methods used in green building practices.
4. Select materials for sustainable built environment & adopt waste management methods.
5. Describe the methods used to maintain indoor environmental quality.

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT- II

Site selection and planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc.

Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Building materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks, (c) use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) reuse of waste and salvaged materials

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management

UNIT-V

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Suggested Readings:

1. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
2. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
3. *Alternative building materials and technologies* by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.
4. *Non-Conventional Energy Resources* by G. D. Rai, Khanna Publishers.
5. *Sustainable Building Design Manual*, Vol.1 and 2, TERI, New Delhi 2004.
6. Mike Montoya, *Green Building Fundamentals*, Pearson, USA, 2010.
7. Charles J. Kibert*, Sustainable Construction - Green Building Design and Delivery*, John Wiley & Sons, New York, 2008.
8. Regina Leffers*, Sustainable Construction and Design*, Pearson / Prentice Hall, USA, 2009.

Course Code	Course Title						Core / Elective
OE 772 CS	**Data Science Using R Programming**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To learn basics of R Programming environment: R language, R- studio and R packages
- To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting
- To learn Decision tree induction, association rule mining and text mining

Course Outcomes:

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

1. Use various data structures and packages in R for data visualization and summarization
2. Use linear, non-linear regression models, and classification techniques for data analysis
3. Use clustering methods including K-means and CURE algorithm

UNIT – I

Data Science: Introduction to data science, Linear Algebra for data science, Linear equations, Distance, Hyper planes, Half spaces, Eigen values, Eigenvectors.

UNIT II

Statistical Modelling, Random variables, Probability mass/density functions, sample statistics, hypothesis testing.

UNIT III

Predictive Modelling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression

UNIT IV

Introduction to R Programming, getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists, Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

UNIT V

Classification: performance measures, Logistic regression implementation in R, K-Nearest neighbours (KNN), K-Nearest neighbours implementation in R, Clustering: K-Means Algorithm, K-Means implementation in R.

Suggested Readings:

1. Nina Zumel, Practical Data Science with R, Manning Publications, 2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly, 2017.
4. Roger D Peng, R Programming for Data science, Lean Publishing, 2016.
5. Rafael A Irizarry, Introduction to Data Science, Lean Publishing,2016.

Course Code	Course Title						Core / Elective
OE 773 EC	**Fundamentals of IoT**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- Discuss fundamentals of IoT and its applications and requisite infrastructure
- Describe Internet principles and communication technologies relevant to IoT
- Discuss hardware and software aspects of designing an IoT system
- Describe concepts of cloud computing and Data Analytics
- Discuss business models and manufacturing strategies of IoT products

Course Outcomes:

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

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT
3. Design simple IoT systems with requisite hardware and C programming software
4. Understand the relevance of cloud computing and data analytics to IoT
5. Comprehend the business model of IoT from developing a prototype to launching a product.

UNIT - I

Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT protocols, Logical Design of IoT: IoT functional Blocks, Communication Models, APIs, IoT enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics (Ref 1)

IoT Applications: Smart Home, Smart Cities, Smart Environment, Smart Energy, Smart Retail and Logistics, Smart Agriculture and Industry, Smart Industry and smart Health (Ref1)

UNIT – II

Internet Principles and communication technology: Internet Communications: An Overview – IP, TCP, IP protocol Suite, UDP. IP addresses – DNS, Static and Dynamic IP addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols – HTTP, HTTPS, Cost Vs Ease of Production, Prototypes and Production, Open Source Vs Closed Source. Prototyping Embedded Devices – Sensors, Actuators, Microcontrollers, SoC, Choosing a platform, Prototyping Hardware platforms – Arduino, Raspberry Pi. Prototyping the physical design – Laser Cutting, 3D printing, CNC Milling (Ref 2)

UNIT – III

API Development and Embedded programming: Getting started with API, writing a new API, Real time Reactions, Other Protocols, Techniques for writing embedded code: Memory management, Performance and Battery Life, Libraries, Debugging. (Ref 2)

Developing Internet of Things: IoT design Methodology, Case study on IoT System for weather monitoring (Ref 1)

UNIT – IV

IoT Systems - Logical Design using Python: Introduction to Python, Data Types and Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/Time Operations., Classes, Python packages for IoT (Ref 1 and Ref 3) IoT Physical Devices and Endpoints: Raspberry Pi, Interfaces of Pi, Programming pi with Python - Controlling LED and LDR using Pi with python programming.

UNIT – V

Cloud computing and Data analytics and IoT Product Manufacturing: Introduction to Cloud storage models and Communication APIs, Amazon web services for IoT, Skynet IoT Messaging Platform. Introduction to Data Analytics for IoT (Ref 1). Case studies illustrating IoT Design – Smart Lighting, Weather Monitoring, Smart Irrigation. (Ref 1) Business model for IoT product manufacturing, IoT Start-ups, Mass manufacturing, Ethical issues in IoT. (Ref 2)

Suggested Readings:

1. Internet of Things (A Hands-On-Approach), Vijay Madisetti, Arshdeep Bahga, VPT Publisher, 1st Edition, 2014.
2. Designing the Internet of Things, Adrian McEwen (Author), Hakim Cassimally. Wiley India Publishers.
3. Fundamentals of Python, Kenneth A Lambert and B.L. Juneja, Cengage Learning
4. *Internet of Things* - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.
5. *Internet of things* -A hands on Approach, Arshdeep Bahga, Universities press.

Course Code	Course Title						Core / Elective
OE 774 EE	**Non-Conventional Energy Sources**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To impart the knowledge of basics of different non-conventional types of power generation & power plants in detail so that it helps them in understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature

Course Outcomes

On completion of course the student will be able to:

1. Understand the different nonconventional sources and the power generation techniques to generate electrical power.
2. Understand the Solar energy power development and different applications.
3. Understand different wind energy power generation techniques and applications.
4. Design a prescribed engineering sub-system
5. Recognize the need and ability to engage in lifelong learning for further developments in this field.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2 °2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells-Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations -Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT- IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-Thermal Energy - Types of Geo-Thermal Energy Systems - Applications of Geo-Thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifiers.

Suggested Readings:

1. Rai G.D, *Non-Conventional Sources of Energy,* Khandala Publishers, New Delhi, 1999.
2. M.M. El-Wakil, Power *Plant Technology.* McGraw Hill, 1984.

Course Code	Course Title						Core / Elective
OE 775 ME	**Entrepreneurship**						**Open Elective-II**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To motivate students to take up entrepreneurship in future
- To learn nuances of starting an enterprise & project management
- To understand the design principles of solar energy systems, their utilization and performance evaluation
- To understand the behavioural aspects of entrepreneurs and time management

Course Outcomes

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

1. Understand Indian Industrial Environment, Entrepreneurship and Economic growth, Small and Large Scale Industries, Types and forms of enterprises.
2. Identify the characteristics of entrepreneurs, Emergence of first generation entrepreneurs, Conception and evaluation of ideas and their sources.
3. Practice the principles of project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis.
4. Apply the concepts of Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques
5. Understand the Behavioural aspects of entrepreneurs, Time Management, Various approaches of time management, their strengths and weakness. The urgency addiction and time management matrix.

UNIT-I

Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

Identification and characteristics of entrepreneurs. Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

UNIT-III

Project formulation, Analysis of market demand, Financial and profitability analysis and Technical analysis, project financing in India.

UNIT-IV

Project Management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Suggested Readings:

1. Vasant Desai, *"Dynamics of Entrepreneurial Development and Management",* Himalaya Publishing House, 1997
2. Prasanna Chandra, *"Project-Planning, Analysis, Selection, Implementation and Review",* Tata McGraw-Hill Publishing Company Ltd. 1995.
3. Stephen R. Covey and A. Roger Merrill, *"First Things First",* Simon and Schuster Publication, 1994.
4. G.S. Sudha, *"Organizational Behaviour",* 1996.
5. Robert D. Hisrich, Michael P. Peters, *"Entrepreneurship",* Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005.

Course Code	Course Title						Core / Elective
OE 781 CE	**Road Safety Engineering**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**0**	**0**	**0**	**30**	**70**	**3**

Course Objectives

- Introduction to various factors considered for road safety and management
- Explain the road safety appurtenances and design elements
- Discuss the various traffic management techniques

Course Outcomes

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

1. Prepare accident investigation reports and database
2. Apply design principles for roadway geometrics improvement with various types of traffic safety appurtenances/tools
3. Manage traffic including incident management

UNIT – I

Road Accidents: Causes, scientific investigations and data collection, Analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of Road accident statistics, Safety performance function: The empirical Bayes method Identification of Hazards road location. Application of computer analysis of accident data.

UNIT – II

Safety in Road Design: Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors & Driver characteristics influencing road safety.

UNIT – III

Road Signs and Traffic Signals: Classification, Location of Signs, measures of sign effectiveness, Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols. Road Marking: Role of Road markings, Classification, visibility. Traffic Signals: Need, Signal face. Illumination and location of Signals, Factors affecting signal design, pedestrians' safety, fixed and vehicle actuated signals. Design of signa1s, Area Traffic control. Delineators, Traffic Impact Attenuators, Road side rest areas, Safety Barriers, Traffic Aid Posts.

UNIT – IV

Traffic Management Techniques: Integrated safety improvement and Traffic Calming Schemes, Speed and load limit, Traffic lights, Safety cameras, Tests on driver and vehicles, pedestrian safety issues, Parking, Parking enforcement and its influence on Accidents. Travel Demand Management; Methods of Traffic management measures: Restriction of Turning Movements, One-way streets, Tidal Flow Operation Methods, Exclusive Bus Lanes and Closing Side-streets; Latest tools and techniques used for Road safety and traffic management. Road safety issues and various measures for road safety; Legislation, Enforcement, Education and Propaganda, Air quality, Noise and Energy Impacts; Cost of Road Accidents.

UNIT – V

Incident Management: Introduction, Characteristics of Traffic Incidents, Types of Incidents, Impacts, Incident management process, Incident traffic management; Applications of ITS: Motorist information, Equipment used; Planning effective Incident management program, Best practice in Incident management

programs. National importance of survival of Transportation systems during and after all natural disasters especially cyclones, earthquakes, floods etc. and manmade disasters like sabotage, terrorism etc.

Suggested Readings:

1. Guidelines on Design and Installation of Road Traffic Signals, IRC:93.
2. Specification for Road Traffic Signals, IS: 7537-1974.
3. Principles and Practice of Highway Engineering by L.R. Kadiyali and N.B. Lal.
4. Hand Book of T.E. Myer Kutz, Editor McGraw Hill, 2004.

Course Code	Course Title						Core / Elective
OE 782 CS	**Software Engineering**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product
- To impart knowledge on various phases, methodologies and practices of software development
- To understand importance of software modelling using UML
- To understand the importance of testing in software development and study various testing strategies and software quality metrics.

Course Outcomes

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

1. Acquire knowledge about different software development processes and their usability in different problem domains.
2. Understand the process of requirements collection, analysing, and modelling requirements for effective understanding and communication with stakeholders.
3. Design and develop the architecture of real world problems towards developing a blueprint for implementation.
4. Use the UML language to design various models during software development life cycle.
5. Understand the concepts of software quality, testing and maintenance.

UNIT-I

The software Problem: Cost, Schedule and Quality, Scale and change, Software Processes: - Process and project, Component Software Processes, Software Development Process Models, Project management Process.

UNIT-II

Software Requirements Analysis and Specification: Value of a good SRS, Requirements Process, Requirements Specification, Functional Specification with Use Cases, Other approaches for analysis. Software Architecture: Role of Software Architecture Views, Component and connector view, Architectural styles for C & C view, Documenting Architecture Design, Evaluating Architectures.

UNIT-III

Planning a Software Project: Effort Estimation, Project Schedule and staffing, Quality Planning, Risk Management Planning, Project Monitoring Plan, Detailed Scheduling. Design: Design concepts, Function oriented Design, Object Oriented Design, Detailed Design, Verification, Metrics.

UNIT-IV

Coding and Unit Testing: Programming Principles and Guidelines, incrementally developing code, managing evolving code, unit testing, code inspection, Metrics. Testing: Testing Concepts, Testing Process, Black Box testing, White box testing, Metrics.

UNIT-V

Maintenance and Re-engineering: Software Maintenance, supportability, Reengineering, Business process Reengineering, Software reengineering, Reverse engineering; Restructuring, Forward engineering, Economics of Reengineering. Software Process Improvement: Introduction, SPI process, CMMI, PCMM, Other SPI Frameworks, SPI return on investment, SPI Trends.

Suggested Readings:

1. Pankaj Jalote, "Software Engineering- A Precise Approach", Wiley India, 2010.
2. Roger. S. Pressman, "Software Engineering - A Practitioner's Approach", 7th Edition, McGraw Hill Higher Education, 2010.
3. Deepak Jain, "Software Engineering", Oxford University Press, 2008.
4. Rajib Mall, "Fundamentals of Software Engineering", 4th Edition, PHI Learning, 2014.
5. Ian Sommerville, "Software Engineering", 10th Edition, Addison Wesley, 2015.

Course Code	Course Title						Core / Elective
OE 783 EC	**Principles of Electronic Communications**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	**Credits**
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Provide an introduction to fundamental concepts in the understanding of communications systems.
- Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer.
- Provide an introduction to the evolution of wireless systems and current wireless technologies.

Course Outcomes

1. Understand the working of analog and digital communication systems
2. Understand the OSI network model and the working of data transmission
3. Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems.

UNIT – I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.

Signal Transmission Concepts: Baseband transmission and Broadband transmission,

Communication Parameters: Transmitted power, Channel bandwidth and Noise, Need for modulation

Signal Radiation and Propagation: Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT – II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT – III

Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT – IV

Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony.

Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT – V

Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

Suggested Readings:

1. *Principles of Electronic Communication Systems*, Louis E. Frenzel, 3e, McGraw Hill, 2008.
2. *Data Communications and Networking,* Behrouz A. Forouzan, 5e TMH, 2012.
3. Kennady, Davis, *Electronic Communications systems*, 4e, McGraw Hill, 1999.

Course Code	Course Title						Core / Elective
OE 784 EE	**Illumination and Electric Traction Systems**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce the students and understand Utilization of electrical energy for various applications like industrial heating, welding etc.,
- To understand the concept of illumination, and know the applications of various lamps to factory lighting, street lighting etc.
- To understand the concept of electrification of traction system

Course Outcomes

On successful completion of course, students will be able to:

1. Design the resistive and inductive heating and calculate the requirements of heating power for an industrial need
2. Analyse the type of motor control required and select the type and rating of motor.
3. Understand and Design illumination for different application
4. Understand the traction and use of DC machines
5. Analyse the traction mechanics to arrive at a rating of drive.

UNIT-I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens — Design of elements. Core type, Coreless type furnaces, High frequency eddy current heating, Dielectric heating. Arc furnace. Electric welding, Resistance welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

UNIT-II

Schematic Utilization and Connection Diagrams for Motor Control: Two supply sources for 3 phase Induction motors. Direct reversing, remote control operation, and jogging operating of Induction motor. Contactor control circuit. Push button control stations. Over load relays, limit switches, float switches. Interlocking methods for reversing control.

UNIT-III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, lighting calculations — Determination of M.S.C.P, Rousseau's construction, Discharge lamps, Sodium vapour lamps, Mercury vapour lamps — Fluorescent lamp, Starting and power factor corrections, Stroboscopic effects — Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT-IV

Electric Traction: System of Electric Traction — Transmission of drive — Systems of track electrification — Traction mechanics — Speed time curves — Tractive effort — Power of Traction motor — Specific energy consumption — Mechanics of train movement— Coefficient of adhesion.

Traction Motors: Desirable characteristics, DC series motors, AC series motors 3-phase induction motors, DC motor series & parallel control, Energy saving.

UNIT-V

Train Lighting: Systems of train lighting — Special requirements of train lighting — Methods of obtaining unidirectional polarity — Methods of obtaining constant output — Single battery system — Double battery parallel block system — Principal equipment of double battery system — Coach wiring — Dynamo.

Batteries: Lead acid batteries, SMF batteries, Construction and maintenance, Charging and rating of batteries.

Suggested Readings:

1. Partab H, Art and Science of Utilization of Electric Power, Dhanpat Rai & Sons, 1997.
2. K.B. Raina & S.K. Bhattacharya, Electrical Design, Estimating and Costing, Wiley Eastern Ltd., 1991.
3. Partab H, Modern Electric Traction, Dhanpat Rai & Sons, 2000.
4. B.L. Theraja, A Text Book of Electrical Technology, S. Chand & Company Ltd, Vol —I.

Course Code	Course Title						Core / Elective
OE 785 ME	**Mechatronics**						**Open Elective-III**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

Student has to understand the

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

Course 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 Readings:

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

Course Code	Course Title						Core / Elective
PC 752 EE	**Microprocessor and Microcontrollers Lab (Common to EEE & EIE)**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Microprocessor & Microcontrollers	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To introduce the architecture of 8, 16 and 32-bit microprocessor and microcontroller.
- To impart microcontroller programming skills in students.
- To familiarize the students with data transfer and interrupt services.

Course Outcomes

After completing this course, the student will be able to

1. Apply the design concepts for development of a process and interpret data.
2. Demonstrate knowledge of programming environment, compiling, debugging, linking and executing variety of programs.
3. Demonstrate documentation and presentation of the algorithms / flowcharts / programs in a record form.
4. Validate the process using known input-output parameters.

List of Experiments:

For 8086:

Section 1: Using MASM/TASM

1. Programs for signed/unsigned multiplication and division.
2. Programs for finding average of N 16-bit numbers.
3. Programs for finding the largest number in an array.
4. Programs for code conversion like BCD numbers to 7-Segment.
5. Programs for compute factorial of a positive integer number

Section 2: ***Using 8086 Kit (Interfacing)***

1. 8279 – Keyboard Display: Write a small program to display a string of characters.
2. 8255-PPI: Write ALP to generate triangular wave using DAC.
3. 8253- Timer/Counter: Application of different modes.
4. 8251-USART: Write a program in ALP to establish Communication between two processors.
5. Traffic Signal Controller.

For 8051:

Section 3: ***Using 8051 Kit (Simple Programs)***

1. Data Transfer – Block move, Exchange, sorting, Finding largest element in an array.
2. Arithmetic Instructions: Multibyte operations.
3. Boolean & Logical Instructions (Bit manipulations).
4. Programs to generate delay, programs using serial port and on-Chip timer/Counter.
5. Use of JUMP and CALL instructions.

Section 4: Program Development using 'C' cross compiler for 8051

1. Square Wave Generation using timers.
2. Interfacing of keyboard and 7-segment Display Module.
3. ADC interfacing for temperature monitoring.
4. DAC interfacing for Generation of Sinusoidal wave.
5. Stepper motor control (clockwise, anticlockwise and in precise angles)

Course Code	Course Title						Core / Elective
PC 753 EE	**Instrumentation Simulation Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 606 EE	**-**	**-**	**-**	**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) Thevenins theorem (ii) Superposition theorem (iii) Maximum power 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 Sinusoidal input.
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
PW 761 EE	**Project Work - I**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**4**	**50**	**-**	**2**

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.

Course Code	Course Title						Core / Elective
SI 762 EE	**Summer Internship**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**-**	**50**	**-**	**2**

Course Objectives

- Produce an accurate record of work performed during the Internship/Co-op
- Apply engineering knowledge to a problem in industry
- Produce a technical report
- Discuss work in a team environment, if relevant to the project
- Conduct herself/himself responsibly, safely, and ethically in a professional environment

Course Outcomes

After completing this course, the student will be able to

1. Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
2. Gain working practices within Industrial/R&D Environments.
3. Prepare reports and other relevant documentation.

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Government or Private Organisations/Computer Industry/Software Companies/R&D Organization for a period of 4-6 weeks. This will be during the summer vacation following the completion of the III-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co-ordinate (person from industry).

The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

- Overview of company/project
- Safety training
- Discussions with project teams
- Background research, review of documents, white papers, and scientific papers
- Planning, designing, and reviewing the planned work
- Executing the plans
- Documenting progress, experiments, and other technical documentation
- Further team discussions to discuss results
- Final report writing and presentation

After the completion of the project, each student will be required to:

1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Award of sessionals are to be based on the performance of the students at the workplace and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks). One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Note: Students have to undergo summer internship of 4-6 weeks at the end of semester VI and credits will be awarded after evaluation in VII semester.

SCHEME OF INSTRUCTION& EXAMINATION
B.E. VIII - SEMESTER
(ELECTRONICS AND INSTRUMENTATION ENGINEERING)

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	**PC 802 EE**	Advance Programmable Logic Controller	3	-	-	3	30	70	3	3
2		Professional Elective – III	3	-	-	3	30	70	3	3
3		Professional Elective – IV	3	-	-	3	30	70	3	3
4		Professional Elective – V	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
5	**PC 852 EE**	Process Instrumentation Lab	-	-	2	2	25	50	3	1
6	**PW 961 EE**	Project Work – II	-	-	16	16	50	100	-	8
			12	**-**	**18**	**30**	**195**	**430**		**21**

Professional Elective – III		
S. No.	Course Code	Course Title
1	**PE 825 EE**	Digital Control Systems
2	**PE 826 EE**	Automation in Process Control
3	**PE 827 EE**	Hydraulic & Pneumatics
4	**PE 828 EE**	Software Design tools for Sensing & Control

Professional Elective – IV		
S. No.	Course Code	Course Title
1	**PE 834 EE**	Power Quality
2	**PE 835 EE**	Advance Digital Signal Processing
3	**PE 836 EE**	Biomedical Signal Processing
4	**PE 837 EE**	Power plant design and safety management

Professional Elective – V		
1	**PE 842 EE**	Energy Management Systems and SCADA
2	**PE 846 EE**	Neural Networks and Fuzzy Logic
3	**PE 847 EE**	Instrumentation for Agricultural and Food Processing Industries
4	**PE 848 EE**	Digital Image Processing

PC: Professional Course PE: Professional Elective
L: Lectures T: Tutorials P: Practical D: Drawing
CIE: Continuous Internal Evaluation **SEE:** Semester End Examination (Univ. Exam)

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

Course Code	Course Title						Core / Elective
PC 802 EE	**Advance Programmable Logic Controller**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 605 EE	**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 programming layouts.
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 other PLCs 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 conversion examples – 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 counter functions.

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
PE 825 EE	**Digital Control Systems**						**Elective**
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 504 EE	**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
PE 826 EE	**Automation in Process Control**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 606 EE	**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 time systems.
5. Describe the communication protocols used in industrial automation.

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
PE 827 EE	**Hydraulics and Pneumatics**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 606 EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To make the student familiar with the concepts of

- To provide an understanding of the working of hydraulic and pneumatic systems.
- To provide an understanding of energy transfer in hydraulic actuators and motors
- To provide knowledge about controlling components of hydraulic and pneumatic systems
- To provide knowledge of design of hydraulic and pneumatic systems and analyse them.

Course Outcomes

After completing this course, the student will be able to

1. Acquire knowledge about working of hydraulic and pneumatic systems.
2. Identify the controlling components of hydraulic and pneumatic systems.
3. Select and prepare a distribution system for compressed air.
4. Compile the design of hydraulic and pneumatic systems and analyse them.
5. Demonstrate the need of pressure and time dependent controls.

UNIT-I

Introduction to Hydraulic Power: Pascal's law and problems on Pascal's Law, continuity equations, Introduction to conversion of units, Structure of Hydraulic Control System. The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps. Hydraulic Actuators: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading.

UNIT-II

Hydraulic Motors: Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance. Control Components in Hydraulic Systems: Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves.

UNIT-III

Hydraulic Circuit Design and Analysis: Control of single and double – acting hydraulic cylinder, regenerative circuit, pump unloading circuit, counter balance valve application, hydraulic cylinder sequencing circuits. Cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, Accumulators. Maintenance of

Hydraulic Systems: Hydraulic oils; desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.

UNIT-IV

Introduction to Pneumatic Control: Choice of working medium, characteristics of compressed air. Structure of pneumatic control system. Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, filters, regulators, lubricators, distribution of compressed air. Pneumatic Actuators: Linear cylinders – types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications.

UNIT-V

Directional Control Valves: Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling, use of quick exhaust valve. Signal

Processing Elements: Use of Logic gates – OR and AND gates pneumatic applications, practical examples involving the use of Logic gates, Pressure dependent controls types construction– practical applications, time dependent controls – principle, construction, practical applications.

Suggested Readings:

1. 1.Anthony Esposito, Fluid Power with applications, Pearson education, Inc., 5th Edition, 2000.
2. Andrew Parr, Pneumatics and Hydraulics, Jaico Publishing Co. 2000.
3. Niranjan Murthy and Dr.R.K. Hegde, Hydraulics and Pneumatics, Sapna Publications, 2013.
4. Majumdar S.R., Oil Hydraulics Systems - Principles and Maintenance, Tata McGraw-Hill, 2001.
5. Majumdar, S.R., Pneumatic Systems – Principles and Maintenance, Tata McGraw Hill, 2007.
6. Srinivasan. R, Hydraulic and Pneumatic Control, Tata McGraw - Hill Education, 2nd Edition, 2012.
7. Shanmugasundaram.K, Hydraulic and Pneumatic controls, Chand & Co, 2006.

Course Code	Course Title						Core / Elective
PE 828 EE	**Software Design Tools for Sensing and Control**						**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 Programming 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.

Course Code	Course Title						Core / Elective
PE 834 EE	**Power Quality**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- The student able to learn and understand the importance of power quality, different power quality issues and their effects in power system network

Course Outcomes

1. Describe the different PQ disturbances and state remedies to improve PQ.
2. Determine voltage sag for different network configurations.
3. Demonstrate the effect of ASD systems on power quality and the effect of voltage sags on operation of various electrical machines.
4. Evaluate harmonic levels for distribution systems.
5. Describe power quality monitoring and measuring techniques.

UNIT-I

Introduction: Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring. Power Quality Data: Data collection, Data analysis, Database structure, Creating PQ databases, Processing PQ data.

UNIT-II

Voltage Sag – Characterization: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, Meshed systems, voltage sag duration. Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-III

PQ Considerations in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications, mitigation of harmonics. Characterization of voltage sags experienced by three-phase ASD systems: Types of sags and phase - angle jumps. Effects of momentary voltage dips on the operation of induction and synchronous motors. Voltage sag coordination for reliable plant operation.

UNIT-IV

Effects of Harmonics on Power Quality: Harmonic analysis of industrial customers, technical barriers in ASDs. Methods of evaluation of harmonic levels in industrial distribution systems. Harmonic effects on transformers. Impact of distribution system capacitor banks on PQ. Guidelines for limiting voltage harmonics.

UNIT-V

Power Quality Monitoring: Introduction, site surveys, Transducers, IEC measurement techniques for Harmonics, Flicker, IEC Flicker meter.

Suggested Readings:

1. Math H.J. Bollen, Understanding Power Quality Problems, IEEE Press, 1999.
2. Roger C. Dugan, MarkF. McGranaghan, Surya Santoso, H.Wayne Beaty, Electrical Power Systems Quality, Second Edition, Tata McGraw-Hill Edition.
3. C. Sankaran, Power Quality, CRC Press, 2002.

Course Code	Course Title						Core / Elective
PE 835 EE	**Advanced Digital Signal Processing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To acquire good knowledge of advanced Digital Signal Processing.
- To acquire good knowledge of wavelet and other related transforms.
- To know the basics of DSP processors.

Course Outcomes

After completing this course, the student will be able to

1. Describe Multi-rate Digital Signal Processing.
2. Explain the techniques for measurement and control of four basic parameters like level temperature, pressure and flow for power station as well as general process control systems.
3. Describe the Wavelet and other related Transform.
4. Explain and design Multi-rate Filter Banks.
5. Explain the DSP Processors.

UNIT-I

Multi-rate Digital Signal Processing: Fundamentals of Multi-rate systems, Basic multi-rate operations, Decimation, interpolation, filter design and implementation of sampling rate conversion, polyphase filter structures, time variant filter, structures, multistage implementation of sampling rate conversion of BP signals, sampling rate conversion by an arbitrary factor, interconnection of building blocks, polyphase representation, multistage implementations.

UNIT-II

Wavelet Transform: Introduction to wavelets, wavelets and wavelet expansion systems, discrete wavelet transform multi resolution formulation of wavelet systems, Haar Wavelet and other wavelet representations, scaling function, wavelet functions, Parseval's theorem.

UNIT-III

Multi-rate Filter Banks: Maximally decimated filter banks, errors created in QMF banks, simple alias free QMF system, power symmetric filter banks, M channel filter banks, polyphase representation, PR systems, alias free filter banks, Linear phase PR QMF banks, cosine modulated filter banks, Wavelet transform and its relation to multi-rate filter banks, paraunitary PR filter banks.

UNIT-IV

Introduction to DSP Processors: Differences between DSP and other p architectures, their comparison and need for special ASPs, RISC & CISC CPUs.

UNIT-V

Overview of DSP Processor Design: Fixed point DSPs – Architecture of TMS 320C 5X, C54X Processors, addressing modes, Assembly instructions, Pipelining and on-chip peripherals. Floating point DSPs: Architecture of TMS 320 – IX.

Suggested Readings:

1. P. P. Vaidyanathan, "Multirate filters and Filter banks", PH International, Englewood Cliffs
2. Rabiner and Schafer, "Multirate Signal Processing", PH International, Englewood Cliffs.

3. C. S. Burrus, Ramesh and A. Gopinath, "Introduction to Wavelets and Wavelet Transform", Prentice Hall Inc.
4. C. Marren & G. Ewess, “A Simple Approach to Digital Signal Processing”, WILEY Inter-science, 1996.
5. K. Shin, “DSP Applications with TMS 32 Family”, Prentice Hall, 1987.

Course Code	Course Title						Core / Elective
PE 836 EE	**Biomedical Signal Processing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PC 505 EE	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To acquire good knowledge of biomedical signal and its signal processing.
- To acquire good knowledge of filter design for biomedical signal.

Course Outcomes

After completing this course, the student will be able to

1. Describe biomedical signal origin & dynamics.
2. Identify artifact in biomedical signal.
3. Design various time domain filtering for the removal of artifact from biomedical signal.
4. Design frequency domain filtering for the removal of artifact from biomedical signal.
5. Explain design methods for event detection.

UNIT-I

Fundamentals of BMI: Preliminaries; Biomedical signal origin & dynamics –ECG
Biomedical signal origin and its dynamics-EEG, EMG etc.

UNIT-II

Filtering for Removal of artifacts -I: Statistical Preliminaries; Time domain filtering (Synchronized Averaging, Moving Average)

UNIT-III

Filtering for Removal of artifacts -II: Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter).

UNIT-IV

Filtering for Removal of artifacts -III: Optimal Filtering: The Weiner Filter and Adaptive Filter- Selecting Appropriate Filters.

UNIT-V

Event Detection: Example events (viz. P, QRS and T wave in ECG) Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection.

Suggested Readings:

1. R M Rangayyan “Biomedical Signal Analysis: A case Based Approach”, IEEE Press, John Wiley & Sons. Inc, 2002
2. Willis J. Tompkins “ Biomedical Digital Signal Processing”, EEE, PHI, 2004
   D C Reddy “Biomedical Signal Processing: Principles and Techniques”, Tata McGraw-Hill Publishing Co. Ltd, 2005
3. J G Webster “Medical Instrumentation: Application & Design”, John Wiley & Sons Inc., 2001 C Raja Rao, S K Guha “Principles of Medical Electronics and Biomedical Instrumentation”, Universities Press, 2001
4. AV Oppenheim and RW Shafer "Discrete-time Signal Processing", Prentice Hall, Englewood Cliffs, NJ, 1989.
5. Steven M. Kay, "Modern spectral estimation theory and application ", Prentice Hall, Englewood Cliffs, NJ, 1988.

Course Code	Course Title						Core / Elective
PE 837 EE	**Power Plant Design and Safety Management**						**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 engineer's handbook – Process Software and Digital Networks.

Course Code	Course Title						Core / Elective
PE 842 EE	**Energy Management Systems and SCADA**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Outline energy management systems and unit commitment and its solution techniques.
- Discuss power generation scheduling with limited energy.
- Describe the architecture, functions and applications of supervisory control and data acquisition (SCADA).
- Apply SCADA in power system automation and communications.

Course Outcomes

After completing this course, the student will be able to

1. Understand energy management centers.
2. Know the principles of power generation scheduling.
3. Be acquainted with the configurations of SCADA
4. Have a knowledge of SCADA communication

UNIT-I

Energy Management Centers: Introduction, Energy management centers and their functions, architectures, recent developments, characteristics of power generating units and economic dispatch, unit commitment (spinning reserve, thermal, hydro and fuel constraints), solution techniques of unit commitment.

UNIT-II

Generation Scheduling: Generation scheduling with limited energy, energy production cost models, budgeting and planning, practical considerations, interchange evaluation for regional operations, types of interchanges, exchange costing techniques.

UNIT-III

Supervisory Control And Data Acquisition: Introduction to supervisory control and data acquisition, SCADA functional requirements and components. SCADA Application: General features, functions and applications, benefits of SCADA, architectures of SCADA, applications of SCADA.

UNIT-IV

SCADA and Power Systems: Configurations of SCADA, RTU (remote terminal units) connections, power systems SCADA and SCADA in power system automation.

UNIT-V

SCADA and Communication: SCADA communication requirements, SCADA communication protocols: past present and future, structure of a SCADA communications protocol.

Suggested Readings:

1. Handschin E, "Energy Management Systems", Springer Verlag, 1st Edition, 1990.
2. Handschin E, "Real Time Control of Electric Power Systems", Elsevier, 1st Edition, 1972.
3. John D Mc Donald, "Electric Power Substation Engineering", CRC press, 1st Edition, 2001.
4. Wood, A J and Wollenberg, B F, "Power Generation Operation and Control", John Wiley and Sons, 2nd Edition 2003.
5. Green, J N Wilson, R, "Control and Automation of Electric Power Distribution Systems", Taylor and Francis, 1st Edition, 2007.
6. Turner, W C, "Energy Management Handbook", Fairmont Pres, 5th Edition, 2004.

Course Code	Course Title						Core / Elective
PE 846 EE	**Neural Networks and Fuzzy Logic**						**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

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, defuzzificaiton 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, 1999.
4. Klir G.J and Folger T.A, Fuzzy sets, Uncertainty and Information, Prentice Hall, New Delhi, 1994.
5. Zdenko Kovacic, Stjepan Bogdan, Fuzzy Controller Design Theory and Applications, CRC Press, 1st edition, 2006.
6. Satish Kumar, Neural Networks–A classroom approach, Tata McGraw-Hill, 2013.

Course Code	Course Title						Core / Elective
PE 847 EE	**Instrumentation for Agricultural and Food Processing Industries**						**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.
- familiarize with current literature, research in agricultural instrumentation
- analyze and design of automation system by evaluating agricultural parameter measurement constraint.

Course Outcomes

After completing this course, the student will be

1. able to understand the necessity of instrumentation in agriculture and food processing.
2. familiarized with instrumentation requirement in agriculture and food processing.
3. able to analyse and design systems/instruments for agriculture and food processing.
4. able to 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
PE 848 EE	**Digital Signal Processing**						**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

- Explain image formation and the role human visual system plays in perception of gray and color image data.
- Apply image processing techniques in both the spatial and frequency (Fourier) domains.
- Design image analysis techniques in the form of image segmentation and to evaluate the Methodologies for segmentation.
- 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. Digital Image Processing- Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 201
2. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014
3. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004

Course Code	Course Title						Core / Elective
PC 852 EE	**Process Instrumentation Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**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
PW 961 CE	**Project Work - 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 –II is to implement and evaluate the proposal made as part of Project Work - 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-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.