

# UEI751C: PROCESS AUTOMATION

## 4 Credits (4-0-0)

### Course Objectives:

1. To convey the importance and benefits of industrial automation.
2. To develop PLC programming skills.
3. To discuss SCADA and DCS for process automation.

### UNIT-I

**Introduction to Industrial Automation:** Utility of automation, General structure of automated process, Examples of some simple automated systems. **Introduction to Programmable Logic Controllers(PLC):** Introduction to PLC operation-The digital concept, Analog signals, The input status file, The output status file, Input and output status files, Sixteen point I/O modules, PLC memory. **Introduction to Logic:** The logic, Conventional ladder v/s LPLC ladder, Series and parallel function of OR, AND, NOT, XOR logic, Analysis of rung. Input modules - Discrete type, Discrete AC and DC type. Output Modules - Discrete type, Solid-state type, Switching relay type.

13 Hrs.

### UNIT-II

**PLC Instructions:** The basic relay instructions normally open and normally closed instructions, Output latching instructions, Understanding relay instructions and the programmable controller input modules, Interfacing start stop pushbutton and motor to PLC, Developing ladder diagram with analytical problems.

13 Hrs.

### UNIT-III

**Timer and Counter Instructions:** On delay and off delay and retentive timer instructions, PLC counter up and down instructions, Combining counters and timers, Developing ladder diagram with analytical problems. **Comparison and Data Handling Instructions:** Data handling instructions, Sequencer instructions - Programming sequence output instructions, Developing ladder diagram with analytical problems.

13 Hrs.

### UNIT-IV

**Supervisory Control And Data Acquisition (SCADA):** Introduction as applied to process control systems. **Distributed Control System (DCS):** Evolution of digital controllers, Advantages of digital control, Process control requirements of digital control, Computer network, Interconnection of networks and communication in DCS. **Different Bus Configurations Used for Industrial Automation:** RS232, RS485, CAN, HART and OLE protocol, Industrial field bus- FIP (Factory Instrumentation protocol), PROFIBUS (Process field bus), Bit bus.(Fundamentals only).

13 Hrs.

### Course Outcomes:

Students will:

- CO1: Elucidate the role of automation in process industry.
- CO2: Describe typical components of PLC and its memory organization.
- CO3: Illustrate the working of PLC instructions and compare electrical relay logic and PLC ladder logic.
- CO4: Develop program for PLC applications.
- CO5: Interpret the role of SCADA and DCS in process control.
- CO6: Appraise the role of buses in industrial communication.

### Text Books:

1. Garry Dunning, "Introduction to Programmable Logic Controllers", 2<sup>nd</sup> Edition. Thomson Publishing, ISBN: 981-240-625-5.
2. Madhuchhanda Mitra and Samarjit Sen Gupta, "Programmable Logic Controllers and Industrial Automation: An Introduction", Penram International Publishing India Pvt Ltd.
3. M. Chidambaram, "Computer control of Processes", Narosa Publishing.

**Reference Books:**

1. Curtis Johnson, "Process Control Instrumentation Technology", Prentice Hall of India.
2. Bela G. Liptak, "Instrumentation Engineers Hand Book – Process Control", Chilton Book Company, Pennsylvania.
3. W.Bolton, "Industrial Control and Instrumentation", Universities Press.

# UEI752C: ADVANCED MICROPROCESSOR

## 3 Credits (3-0-0)

### Course Objectives:

1. To inculcate the basics of microprocessors
2. To enhance programming skills
3. To impart the knowledge on interfacing peripherals

### UNIT-I

**Introduction to microprocessor:** A historical background, the microprocessor-based personal computer system. **Architecture of 8086:** Special functions of General purpose registers, Physical memory organization, 8086 flag register, **Pin Diagram of 8086:** Minimum and Maximum mode of operation, Timing Diagram.

**10 Hrs.**

### UNIT-II

**Addressing Modes of 8086:** Data addressing modes, program memory addressing modes, stack memory addressing modes, Assembler Directives, **Instruction set of 8086:** Data movement instructions, arithmetic and logic instructions, program control instructions, Assembly language programs involving logical, branch and call instructions, Sorting, Evaluation of arithmetic expressions, String manipulation, Procedures and macros.

**10 Hrs.**

### UNIT-III

**Memory interface:** Address decoding, 8088/8086 memory interface (Static RAM & EPROM), **Direct Memory Access:** Need for DMA, DMA data transfer method, Interfacing with 8237/8257, **Interrupts:** Interrupt structure of 8086, Vector interrupt, Interrupt service routines, Introduction to DOS interrupts

**10 Hrs.**

### UNIT-IV

**Peripheral interrupt controller:** 8259 PIC Architecture and interfacing cascading of interrupt vector controller and its importance, **8255 PPI:** Various modes of operation and interfacing to 8086, Interfacing keyboard, Displays, Salient features of 80286, 80386 and 80586 advanced microprocessors.

**10 Hrs.**

### Course Outcomes:

Students will:

- CO1: Define the basic components of 8086 microprocessor.
- CO2: Distinguish various addressing modes and instructions of 8086 microprocessor.
- CO3: Apply the knowledge of 8086 instructions for developing the program.
- CO4: Develop programs for 8086 based systems.
- CO5: Design system with memory and other peripheral devices.
- CO6: Analyze the given 8086 program to identify the errors or output.

### Text Books:

1. Barry B. Brey, "The Intel Microprocessors," 8<sup>th</sup> Edition, Pearson Education, 2009.
2. Douglas V. Hall, "Microprocessors and interfacing," 2<sup>nd</sup> Edition, TMH, 2010

### Reference Books:

1. Y.C. Liu, G. A. Gibson, "Microcomputer systems-The 8086 / 8088 family," 2<sup>nd</sup> Edition, PHI, 2003.
2. A.K. Ray and K.M. Bhurchandi, "Advanced microprocessors and peripherals," TMH, 2001.

# UEI753C: NEURAL NETWORKS AND FUZZY LOGIC

4 Credits(4-0-0)

## Course Objectives:

1. To provide comprehensive knowledge of ANN and Fuzzy logic.
2. To comprehend the concept of fuzziness and fuzzy set theory.
3. To develop fuzzy system models.

## UNIT-I

**Introduction to Neural Networks:** What is neural network, Human Brain, Models of a Neuron, Neural Networks viewed as directed graphs, Feedback, Network architectures, Knowledge Representation, Artificial Intelligence and Neural Networks. **Learning Processes:** Introduction, Error correction learning, Memory based learning, Hebbian Learning.

13 Hrs.

## UNIT-II

Competitive learning, Boltzmann learning, credit assignment problem, learning with a teacher, learning without a teacher, Learning tasks . **Single layer Perceptrons:** Introduction, Perceptron, and perception convergence theorem, Multilayer perceptrons: Introduction, Some preliminaries, Back Propagation Algorithm, XOR Problem.

13 Hrs.

## UNIT-III

**Hopfield Networks and Boltzmann Machine:** Analysis of the Hopfield net, energy minimization, dynamics, ising models, learning, capacity and phase transitions, continuous networks, optimization using neural networks, Boltzmann machines, finding minima. **Introduction to Fuzzy Logic:** Uncertainty and Imprecision, statistics and random processes, Uncertainty in information, fuzzy sets and membership, classical sets, operations on classical sets, properties of classical sets, mapping of classical sets to function, fuzzy set operation, properties of Fuzzy sets, Sets as points in Hypercubes.

13 Hrs.

## UNIT-IV

**Classical relations and fuzzy relations:** Cartesian product, crisp relations, fuzzy relations, tolerance and equivalence relations, fuzzy tolerance and equivalence relations, membership functions: Features of membership functions, standard forms and boundaries, fuzzification, membership value assignment. Fuzzy to crisp conversions: lambda cuts for fuzzy sets, lambda cuts for fuzzy relations, defuzzification methods.

13 Hrs.

## Course Outcomes:

Students will:

- CO1: Describe the fundamentals of neural networks and fuzzy logic.
- CO2: List various types of neural networks and fuzzification methods.
- CO3: Illustrate different types of neural networks, fuzzy methods and learning process.
- CO4: Analyze different networks and fuzzy methods.
- CO5: Critically examine networks and fuzzy methods.
- CO6: Apply fuzzy logic methods for specific real time problems.

## Text Books:

1. Simon Haykin, "Neural Networks - A Comprehensive Foundation", McMillan College Publishing Company, New York, 1994.
2. James A. Anderson, "An introduction to Neural Networks", Prentice Hall of India.
3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill International Edition, 1997.

## Reference Books:

1. Jacek M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House.
2. Robert J. Schalkoff, "Artificial Neural Networks", McGraw Hill International Edition, 1997.
3. Bart Kosko, "Neural Networks and Fuzzy Systems, A Dynamical Systems Approach to Machine Intelligence", Prentice Hall of India Publications, 2006.

**UEI754H: PROFESSIONAL COMMUNICATION AND TECHNICAL  
WRITING  
3 CREDITS (3-0-0)**

**Course Objectives:**

1. To impart basics of communication and business etiquettes.
2. To develop an ability to prepare business letter, report and technical writing.
3. To develop the overall personality.

**UNIT-I**

**Communication in the Workplace:** Role of communication in business, Process of human communication, Feedback, Elements, Objectives, Principles of communication, Importance of communication, Barriers in communication. **Communication in Organization:** Formal and informal communication, Verbal and non-verbal communication, Oral and written communication, Horizontal and vertical communication, Internal and external communication using telephone.

**10 Hrs.**

**UNIT-II**

**Writing for the effect:** Business etiquette and need for effect, Conversational style, You-view Point, Positive language, Courtesy. **Listening:** Introduction, Meaning of listening, Poor listening habits, Types of listening, Effective and ineffective listening skills, Strategies for effective listening, Payoffs of effective listening, Barriers of effective listening, Role of listening in leadership style. **Public Speaking and Oral Reporting:** Making formal speeches, seminar presentation.

**10 Hrs.**

**UNIT-III**

**Constituents of Effective Writing:** Sentence construction, Paragraph development, The art of condensation. **Written Forms of Communication:** Letters- Business letters, Memos, E-mails, Reports- Objectives, Characteristics of a report, Types of reports, Importance of reports, Formats, Prewriting, Structure of reports, Writing the reports, Revising, Editing and proof reading. Technical proposals- Definition, Purposes, Types, Characteristics, Elements of structure, Evaluation.

**10 Hrs.**

**UNIT-IV**

**Research Paper, Dissertation:** Instruction manuals and technical description- Instruction manuals, Types of instructions, Writing instructions, User's manuals, Technical description, Process description. **Correctness of Communication:** Common Errors in usage, Punctuation and capitalization, words commonly miss-spelt.

**10 Hrs.**

**Course Outcomes:**

Students will:

- CO1: Describe and exhibit the concepts of communication.
- CO2: Compare various types of communication.
- CO3: Interpret business etiquettes.
- CO4: Comprehend the hearing and listening skills.
- CO5: Prepare and justify business letter, report and technical writing.
- CO6: Get better career, lead good life, improve inter person communication and help society

**Text Books:**

1. Lesikar and Fatley , "Basics Business Communication Skills for Empowering the Internet Generation", 10<sup>th</sup>Edition, Tata McGraw Hill, ISBN: 978-0-07-059975-8.
2. Meenakshi Raman, Sangeeta Sharma, "Technical Communication Principles and Practices", Oxford University Press, ISBN-13 978-0-19-566804-9.
3. Meenakshi Raman, Prakash Singh, "Business Communication", Oxford University Press, ISBN-13: 978-0-19-567695-2.

**Reference Books:**

1. M. Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill Company Limited, ISBN: 978-0-07-059952-9.
2. P. D. Chaturvedi, Mukesh Chaturvedi, "Business Communication - Concepts, Cases and Application", Pearson Education, ISBN:81-317-0172-7.
3. Rajendra Pal, J. S. Khorahalli , "Essential of Business Communication", S. Chand and Sons Publications.
4. Urmita Rai, S. M. Rai, "Business Communication", Himalaya Publishing House.
5. Krishna Mohan, Meera Banerjee , "Developing Communication Skills", McMillan India Ltd.
6. Asha Kaul, "Business Communication", Prentice Hall of India Pvt Ltd.

# UEI771E: RENEWABLE ENERGY

3 Credits (3-0-0)

## Course Objectives:

1. To define renewable energy and to introduce the different renewable energy technologies in an Indian context.
2. To enumerate and discuss the strengths and weaknesses of renewable energy technologies.
3. To review the issues affecting effective deployment of renewable energy systems

## UNIT-I

**Introduction to Energy Sources:** Importance of energy consumption as measure of prosperity, per capita energy consumption, classification of energy resources; conventional energy resources – availability and their limitations; non-conventional energy resources: Classification, advantages, limitations; comparison of conventional and non-conventional energy resources. **Solar energy basics:** Introduction, solar constant, basic sun-earth angles – definitions and their representation, solar radiation geometry (only theory); Measurement of solar radiation data: Pyranometer and pyroheliometer. **Solar thermal systems:** Principle of conversion of solar radiation into heat, solar water heaters (Flat plate collectors), Solar cookers: box type, concentrating dish type; solar driers, solar still.

10 Hrs.

## UNIT-II

**Solar Electric Systems:** Solar thermal electric power generation: Solar pond and concentrating solar collector (parabolic trough, parabolic dish, central tower collector). Advantages and disadvantages; Solar photovoltaic: Solar cell fundamentals, module, panel and array. Solar PV systems: Street lighting, domestic lighting and solar water pumping systems. **Wind energy:** Wind and its properties, history of wind energy, wind energy scenario – world and India. Basic principles of wind energy conversion systems (WECS), classification of WECS, parts of a WECS, derivation for power in the wind, advantages and disadvantages of WECS.

10 Hrs.

## UNIT-III

**Biomass Energy** Introduction, photosynthesis process, biomass conversion technologies; Biomass gasification: Principle and working of gasifiers; Biogas: production of biogas, factors affecting biogas generation, types of biogas plants – KVIC and Janata model. **Geothermal Energy:** Introduction, geothermal resources (brief description), advantages and disadvantages, applications of geothermal energy.

10 Hrs.

## UNIT-IV

**Energy from Ocean:** Tidal energy: Principle of tidal power, components of tidal power plant (TPP), classification of tidal power plants, advantages and limitation of TPP. Ocean thermal energy conversion (OTEC): Principle of OTEC system, methods of OTEC power generation: Open cycle (Claude cycle), closed cycle (Anderson cycle) and hybrid cycle (block diagram description of OTEC), advantages & limitation of OTEC. **Emerging Technologies:** Fuel cell, hydrogen energy, and wave energy. (Principle of energy generation using block diagrams, advantages and limitations).

10 Hrs.

## Course Outcomes:

Students will:

- CO1: List the types of renewable energy sources and their advantages.
- CO2: Distinguish different renewable energy sources.
- CO3: Describe the technologies for renewable energy.
- CO3: Identify and assess the strength and weaknesses of different potential renewable energy sources.
- CO4: Design method for harnessing a specific renewable energy.
- CO5: Use renewable energy source for a particular system.
- CO6: Implement a renewable energy sourced project (or application).

**Text Books:**

1. Rai G. D., “Non-Conventional Sources of Energy”, 4<sup>th</sup> Edition, Khanna Publishers, 2007.
2. Khan B. H., “Non-Conventional Energy Resources”, TMH, New Delhi, 2006.

**Reference Books:**

1. Mukherjee D., Chakrabarti, S., “Fundamentals of Renewable Energy Systems”, New Age International Publishers, 2005.
2. Tiwari, G. N., Ghosal M. K., “Renewable Energy Sources: Basic Principles and Applications”, Alpha Science International Ltd., New Delhi, 2006.

# UEI772E: WIRELESS COMMUNICATION

3 Credits (3-0-0)

## Course Objectives:

1. To impart cellular network systems and their generations.
2. To describe the wireless network architecture and operation.
3. To discuss cellular network modulation techniques.

## UNIT-I

**Evolution and Deployment of Cellular Telephone Systems:** Different generations of wireless cellular networks, 1G, 2G, 2.5G, 3G and 4G cellular systems. **Common Cellular System Components:** common cellular network components, hardware and software views of cellular networks, 3G cellular system components, Cellular component identification, Call establishment.

10 Hrs.

## UNIT-II

**Wireless Network Architecture and Operation:** Cellular concept, Cell fundamentals, Capacity expansion techniques, Cellular backbone networks, Mobility management, Radio resources and power management **Wireless network security, CDMA technology:** CDMA overview, CDMA network and system architecture.

10 Hrs.

## UNIT-III

**GSM and TDMA Techniques:** GSM system overview, GSM Network and system Architecture, GSM channel concept. **GSM System Operation:** GSM identities, GSM system operations (traffic cases), Call handoff, GSM infrastructure communications (Um interfaces), other TDMA systems.

10 Hrs.

## UNIT-IV

**Wireless Modulation Techniques and Hardware:** Transmission characteristics of wire line and fiber system, Characteristics of air interface, Path loss models, wireless coding techniques, Digital modulation techniques, Spread spectrum modulation techniques, UWB radio techniques, Diversity techniques. Introduction to wireless LAN 802.11X technologies, Evolution of Wireless LAN, IEEE 802.11 design issues.

10 Hrs.

## Course Outcomes:

Students will:

- CO1: Define the characteristics of different generations of cellular networks
- CO2: Identify the basic functions of common cellular system components.
- CO3: Classify the different generations of wireless networks.
- CO4: Comprehend the Architecture and operation of wireless mobile network and capacity expansion techniques.
- CO5: Describe the operation of GSM system, GSM protocol architecture, TDMA and CDMA systems.
- CO6: Discuss different wireless modulation techniques and working of different wireless technologies.

## Text Books:

1. Gary J. Mullet, "Wireless Telecom Systems and Networks", Thomson Learning, 2006

## Reference Books:

1. Lee W.C.Y., "Mobile Cellular Telecommunication", McGraw Hill, 2002.
2. D. P. Agrawal, "Wireless Communication", Thomson Learning, 2007.
3. David Tse, Pramod Viswanath, "Fundamentals Of Wireless Communication", Cambridge, 2005.

# UEI773E: MEDICAL IMAGING TECHNIQUES

3 Credits (3-0-0)

## Course Objectives:

1. To discuss concepts of medical imaging techniques.
2. To articulate algorithms for medical image processing.
3. To discuss the different object recognition methods.

## UNIT-I

**Introduction:** Basic imaging principle, Physical signals, Imaging modalities-Projection radiography, Computed Tomography, Nuclear medicine, Ultrasound imaging, Magnetic Resonance Imaging. **X-Ray :**Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers, X-Ray detectors, Conventional X-Ray radiography, Fluoroscopy, Angiography, Digital radiography, Dynamic spatial reconstructor, Electron beam CT, X-Ray image characteristics, Biological effects of ionizing radiation.

10 Hrs.

## UNIT-II

**Computed Tomography:** Conventional tomography, Computed tomography principle, Generations of CT machines – First, Second, Third, Fourth, Fifth, Sixth & Seventh.**Ultrasound :**Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Transducer Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging, Echocardiography.

10 Hrs.

## UNIT-III

**Radio Nuclide Imaging:** Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, Nuclear radiation detectors, Rectilinear scanner, scintillation camera, SPECT, PET.

10 Hrs.

## UNIT-IV

**Magnetic Resonance Imaging:** Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency, Rotating frame of reference, Free induction decay, Relaxation times, Pulse sequences, Generation and Detection of NMR Imager. Slice selection, Frequency encoding, Phase encoding, Spin-Echo imaging, Gradient-Echo imaging, Imaging safety, Biological effects of magnetic field, Introduction to Functional MRI.

10 Hrs.

## Course Outcomes:

Students will:

- CO1: Define basic imaging principles.
- CO2: Identify techniques used to handle medical images.
- CO3: Analyze the compression principles and techniques applied for medical images.
- CO4: Interpret various medical image processing algorithms.
- CO5: Apply image segmentation techniques for medical images.
- CO6: Implement morphological image processing algorithms.

## Text Books:

1. K. Kirk Shung, Michael B Smith, Benjamim M. W. Tsui, "Principles of Medical Imaging," Academic Press Inc.
2. Jerry L. Prince, Jonathan M. Links, "Medical Imaging Signals and Systems," Pearson Prentice Hall.

# UEI774E:OPERATING SYSTEMS

3 Credits (3-0-0)

## Course Objectives:

1. To impart the fundamental concepts of OS.
2. To discuss the mechanism of processes and thread communication.
3. To explain memory management and scheduling.

## UNIT-I

**Introduction to Operating Systems and System Structures:** What operating systems do, Computer system organization, Computer system architecture, Operating system Structure, Operating system operations, Process management, Memory management, Storage management, Protection and security, Distributed system, Special purpose systems, Computing environments, Operating System Services, User - operating system interface, System calls, Types of system calls, System programs.

10 Hrs.

## UNIT-II

**Process Management: Overview, operations on process.Process Scheduling: Basic concepts. Scheduling criteria, scheduling algorithms, multiple processors scheduling.Deadlocks:** System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection and recovery from deadlock.

10 Hrs.

## UNIT-III

**Memory Management Strategies:** Background, swapping, contiguous memory allocation, paging, structure of the page table, segmentation of the page table, segmentation. **Virtual Memory Management:** Background, demand paging, page replacement, allocation of frames, thrashing.

10 Hrs.

## UNIT-IV

**File System Concept and Implementation:** File concept, access methods, directory structure, file system mounting. **Implementing File Systems:** File system structure, file system implementation, directory implementation, allocation methods, free space management. **Protection and Security:** Goals of protection, domain of protection, access matrix, implementation of access matrix, revocation of access rights, the security problem, program threats, system and network threats.

10 Hrs.

## Course Outcomes:

Students will:

- CO1: Identify structure of operating systems and formulate the operating system Requirements.
- CO2: Visualize the purpose and basic concept of operating system.
- CO3: Analyze various scheduling techniques.
- CO4: Interpret information handling and various resource control methods.
- CO5: Apply the principles of concurrency and synchronization to provide solution to the concurrent programs/software.
- CO6: Demonstrate competence in select and apply operating system features in solving problems related to operating system

## Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “**Operating System Principles**”,7<sup>th</sup> Edition, John Wiley & Sons, 2003.

## Reference Books:

1. Milan Milankovic, “**Operating System Concepts and Design**”, 2<sup>nd</sup> Edition, McGraw Hill, 1992.
2. Harvey M. Deital, “**Operating Systems**”, Addison Wesley, 1990.
3. D.M Dhamdhare, “**Operating Systems Concepts Based Approach**”, Tata Mc Graw Hill, 2002

# UEI781E: EMBEDDED SYSTEMS DESIGN

3 Credits (3-0-0)

## Course Objectives:

1. To discuss basic concepts of embedded systems and different peripheral interfaces.
2. To practice embedded system programming.
3. To give insight of various microcontrollers.

## UNIT-I

**Introduction to Embedded Systems:** Definition, over view of architecture, Application areas, Specialties, Recent trends. **Architecture of Embedded Systems:** Hardware architecture, Software architecture, Application software, Communication software, Process of generating executable image, Development/ testing.

10 Hrs.

## UNIT-II

**Programming for Embedded Systems:** Overview of ANSI C, GNU development tools, Bit manipulation using C, Memory management, Timing of programs, Device drivers, Productivity tools, Code optimization, C coding guidelines, Programming in C++. **The Process of Embedded System Development:** The development process, Requirements engineering, Design, Implementation, Integration and testing, Packaging, Managing projects.

10 Hrs.

## UNIT-III

**Hardware Platforms:** Types, 89C51 microcontroller development board, AVR microcontroller development board. **Communication Interfaces:** Need, RS232/UART, RS422/RS485, and Bluetooth. **Overview of Real Time Operating Systems:** Off-the-shelf, Embedded and handheld.

10 Hrs.

## UNIT-IV

**Embedded Systems Applications Using Intel Strong ARM platform:** Architecture of Proyog, applications, Advanced applications.

10 Hrs.

## Course Outcomes:

Students will:

CO1: Define the building blocks of embedded systems.

CO2: Explain the system development process.

CO3: Apply software-hardware integration knowledge to design an embedded solution.

CO4: Distinguish between various embedded system design models.

CO5: Analyze a given embedded system and identify its critical performance.

CO6: Design and develop embedded based systems.

## Text Book:

1. Dr. K. V. K. K. Prasad, "Embedded / Real-time systems, Design Concepts and Programming", Dreamtech Press, 2009.

# UEI782E: VLSI DESIGN

## 3 Credits (3-0-0)

### Course Objectives:

1. To impart basic concepts of MOS technology.
2. To design layout for digital circuits.
3. To provide adequate knowledge of semiconductor memories.

### UNIT-I

**Introduction to MOS Technology:** Introduction to integrated circuit technology, Metal oxidesemiconductor and related VLSI technology, Basic MOS transistors, enhancement mode transistor action, depletion mode transistor, nMOS fabrication, CMOS fabrication, BiCMOS technology.**Basic Electrical Properties of MOS and BiCMOS Circuits:** Drain to source current verses Voltage characteristics, threshold voltage, trans-conductance, nMOS inverter, determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, MOS transistor circuit model, BiCMOS inverters.

**10 Hrs.**

### UNIT-II

**MOS and BiCMOS Circuit Design Process:** MOS layers stick diagrams, nMOS design style, CMOS design style, designs rules and layout, and lambda based design rules.**Basic Circuit Concept:** sheet resistance, area capacitance calculation, delay unit, inverter delay, driving large capacitive loads, super buffers, wiring capacitance.

**10 Hrs.**

### UNIT-III

**Subsystem Design and Layout:** architectural issues, gate (restoring) logic, examples of structuredesign (combinational logic)- a parity generator, Bus arbitration logic for n-line bus, multiplexers. **Subsystem Design Process:** General consideration, design process- 4 bit arithmetic processor.

**10 Hrs.**

### UNIT-IV

**Semiconductor memories:** Introduction, Dynamic random access memory, static random-access memory, nonvolatile memory, flash memory, Ferro electric random access memory.

**10 Hrs.**

### Course Outcomes:

Students will:

- CO1: Describe the static and dynamic behavior of MOSFETs.
- CO2: Recognize about the trends in semiconductor technology, and how it impacts scaling and its effect on device density, speed and power consumption.
- CO3: Produce Stick diagrams, Fabrication steps.
- CO4: Compute the interconnect delay and noise.
- CO5: Describe the principle operation of different types of memories.
- CO6: Design various circuits for RAM.

### Text Books:

1. Douglas A. Pucknell, Kamran Eshraghian, "Basic VLSI Design", 3<sup>rd</sup> Edition, PHI.
2. Sung Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits, Analysis and Design", 3<sup>rd</sup> Edition, Tata McGraw Hill.

### Reference Books:

1. S. M. Sze, "VLSI Technology", 2<sup>nd</sup> Edition, Tata McGraw Hill.

# UEI783E: PROCESS MODELING AND SIMULATION

## 3 Credits (3-0-0)

### Course Objectives:

1. To define and classify process modeling and simulation techniques.
2. To describe the approaches of process modeling and simulations.
3. To give insight of various techniques in lumped and distributed process modeling.

### UNIT-I

**Introduction to Modeling:** A systematic approach to model building, classification of models.

**Principles of Process Systems and Models:** Conservation principles, thermodynamic principles. Development models of steady state and dynamic lumped and distributed parameter models based on first principles. **Analysis of Ill-conditioned Systems:** Meaning and methods.

10 Hrs.

### UNIT-II

**Process Modeling:** Development of grey box models. Empirical model building, Statistical model calibration and validation. Population balance models. Examples.

10 Hrs.

### UNIT-III

**Solutions to Lumped Process Models:** Solution strategies for lumped parameter models. Stiff differential equations. Solution methods for initial value and boundary value problems. Euler's method, R-K method, shooting method, finite difference methods. Solving the problems using MATLAB/SCILAB.

10 Hrs.

### UNIT-IV

**Solutions to Distributed Process Models:** Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Finite element and finite volume methods.

10 Hrs.

### Course Outcomes:

Students will:

- CO1: Classify models.
- CO2: Identify methods and their suitability for various process modeling.
- CO3: Develop process modeling.
- CO4: Find solution for lumped parameter models.
- CO5: Find solution for distributed parameter models.
- CO6: Be able to use MATLAB/SCILAB in modeling.

### Text Books:

1. K. M. Hangos, I. T. Cameron, "Process Modeling and Model Analysis", Academic Press, 2001.
2. W.L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", 2<sup>nd</sup> Edition, McGraw Hill Book Co., New York, 1990.
3. W. F. Ramirez, "Computational Methods for Process Simulation", Butterworths, 1995.

### Reference Books:

1. Park E. Davis, "Numerical Methods and Modeling for Chemical Engineers", John Wiley & Sons, 1984.
2. Singiresu S. Rao, "Applied Numerical Methods for Engineers and Scientists" Prentice Hall, Upper Saddle River, NJ, 2001.

# **UEI784E: DIGITAL IMAGE PROCESSING**

## **3 Credits (3-0-0)**

### **Course Objectives:**

1. To describe the basics of Digital Image Processing.
2. To illustrate different image processing techniques.
3. To impart image processing skills in practical applications.

### **UNIT-I**

**Digital Image Fundamentals:** Introduction, Fundamental steps in digital image processing (DIP), Components of DIP system, Simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing fundamentals and models. Two-dimensional mathematical preliminaries, 2D transforms: DFT,DCT, KLT, SVD.

**10 Hrs.**

### **UNIT-II**

**Image Enhancement:** Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional smoothing, median, Geometric mean. **Image Restoration:** Image restoration - degradation model. Unconstrained restoration: Lagrange multiplier. Constrained restoration, Inverse filtering-removal of blur caused by uniform linear motion, Wiener filtering.

**10 Hrs.**

### **UNIT-III**

**Image Segmentation:** Edge detection, Edge linking via Hough transform, Thresholding, Region based segmentation, Region growing, Region splitting and merging, Segmentation by morphological watersheds, Basic concepts, Dam construction, Watershed.

**10 Hrs.**

### **UNIT-IV**

**Image Compression:** Need for data compression, Huffman, Run length encoding, Shift codes, arithmetic coding, Vector quantization, Transform coding, JPEG standard, MPEG.

**10 Hrs.**

### **Course Outcomes:**

Students will:

- CO1: Analyze general terminology of digital image processing.
- CO2: Examine various types of images, intensity transformations and spatial filtering.
- CO3: Apply image enhancement techniques in practical applications.
- CO4: Apply image restoration techniques in practical applications.
- CO5: Apply image segmentation techniques in practical applications.
- CO6: Apply image compression techniques in practical applications.

### **Text Books:**

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, 2<sup>nd</sup> Edition, 2004.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", 2<sup>nd</sup> Edition Pearson.

### **Reference Books:**

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education Inc., 2004.
3. D. E. Dudgeon, R. M. Mersereau, "Multidimensional Digital Signal Processing",Prentice Hall

# UEI765L: PROCESS INSTRUMENTATION AND CONTROL LABORATORY

1 Credits (0-0-2)

## Course Objectives:

1. To give hands on of PLC programming and interfacing.
2. To give an exposure to key data acquisition techniques.
3. To make use of computers for process control.

## List of Experiments:

### Part A (PLC):

1. Implementation of Boolean functions using PLC.
2. Sequential control experiments using PLC. Logic should be solved using ladder diagram technique.
3. Experiments on timers and counter instructions of PLC.
4. Interfacing external devices to PLC.
5. Implementation of automatic bottle filling process using PLC.
6. Implementation of control of conveyer belt using PLC.
7. Implementation of elevator control using PLC.

### Part B (Data Acquisition):

1. Interfacing the analog signal (sensors) to the computer using available DAQ boards and DASyLab software.

### Part C (Computerized Process Control):

1. Interfacing the level process station to the computer using available arrangement and controlling it through PID controller.
2. Interfacing the flow process station to the computer using available arrangement and controlling it through PID controller.

## Course Outcomes:

Students will:

CO1: Design and develop a system/write program for the given objective.

CO2: Conduct the experiment/ execute the program and demonstrate the theoretical concepts..

CO3: Analyze and interpret the results.

## **UEI871E: JAVA**

### **3 Credits (3-0-0)**

#### **Course Objectives:**

1. Gain knowledge about basic Java language syntax and semantics to write Java programs
2. Understand the fundamentals of object-oriented programming in Java,
3. Understand the principles of inheritance, packages and interfaces
4. Understand the concept of exception handling and AWT

#### **UNIT-I**

**Evolution of Java:** Java's Lineage, the creation of Java, Java changed the internet, byte code, Java buzzwords, an overview of Java, data types, variables and arrays, operators, control statements

**10 Hrs.**

#### **UNIT-II**

**Introducing classes:** Class fundamental, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, garbage collection

**Methods and classes:** Overloading methods, using object as parameters, argument passing, returning objects, recursion, access control, static, introducing final,

**10 Hrs.**

#### **UNIT-III**

**Inheritance:** Inheritance, Using super, creating a multilevel hierarchy, when constructors are called, method overriding, dynamic method dispatch, using abstract classes, using final with Inheritance, the object class.

**Packages and Interfaces:** packages, access protection, importing packages, interfaces.

**10 Hrs.**

#### **UNIT-IV**

**Exception handling:** Fundamentals, exception types, uncaught exception, using try and catch, Multiple catch clauses, Nested try Statements, throw and finally statements.

**AWT:** AWT classes, window fundamentals, working with frame windows, creating window programs, displaying information within a window

**10 HRS**

**Total Hrs.: 40**

#### **Course Outcomes:**

##### **Students will be able to:**

- CO1:** Set up Java JDK environment to create, debug and run Java programs.
- CO2:** Learn object oriented concepts using programming examples
- CO3:** Study the concepts of inheritance and importing of packages
- CO4:** Study the concept of exception handling mechanism and AWT concepts

#### **TEXT BOOKS:**

1. Herbert Schildt, "Java The Complete Reference", 7<sup>th</sup> Edition, Tata McGraw Hill, 2007

#### **REFERENCE BOOKS:**

1. E Balagurusamy, "Programming with Java", 6<sup>th</sup> Edition, MGH

# UEI872E: ARM PROCESSORS

## 3 Credits (3-0-0)

### Course Objectives:

1. To give insight of processor design and fundamentals of ARM processor.
2. To discuss ARM and THUMB instruction set.
3. To highlight various processor architectures.

### UNIT-I

**An Introduction to Processor Design:** Processor architecture and organization, Abstraction in Hardware design, MU0- A Simple processor, Instruction set design, Processor design trade-offs, The reduced instruction set computer, Design for low power consumption. **The ARM Architecture:** The Acorn RISC machine, Architectural inheritance, The ARM programmer's model, **ARM Organization and implementation:** 3-stage pipeline ARM organization, 5-stage pipeline ARM organization.

10 Hrs.

### UNIT-II

**The ARM Instruction Set:** Introduction, Exceptions, Conditional execution, Branch and branch with link (B, BL), Branch, Branch with link and exchange (BX, BLX), Software interrupt (SWI), Data processing instructions, Multiply instructions, Count leading zeros (CLZ - Architecture V5t Only), Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions, Multiple register transfer instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions, General register to status register transfer instructions.

10 Hrs.

### UNIT-III

**Architectural Support for High-level Languages:** Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops, Functions and procedure. **ARM Processor Cores:** ARM7TDMI, ARM9TDMI.

10 Hrs.

### UNIT-IV

**Architectural Support for Operating Systems:** An introduction to operating systems, The ARM system control coprocessor, CP15 protection unit registers, ARM protection unit, CP15 MMU registers, ARM MMU architecture, **ARM CPU Cores:** The ARM710T, ARM720T, and ARM740T.

10 Hrs.

### Course Outcomes:

Students will:

CO1: Describe the fundamentals of ARM processor design.

CO2: Distinguish architectural aspects of CICS and RISC.

CO3: Compute the output for ARM instructions.

CO4: Analyze the given set of ARM instructions.

CO5: Differentiate various ARM cores.

CO6: Summarize the characteristics, components, and concepts of ARM cores.

### Text Books:

1. Steve Furber, "ARM- System on Chip- Architecture", 2<sup>nd</sup> Edition, Pearson.

# UEI873E: DIGITAL CONTROL SYSTEMS

3 Credits (3-0-0)

## Course Objectives:

1. To study the importance of sample data control system.
2. To give adequate knowledge about signal processing in digital control.
3. To introduce the design concepts of modeling of discrete systems and stability analysis of discrete data system.

## UNIT-I

**Signal Processing in Digital Control:** Configuration of the basic digital control scheme, time-domain models for discrete-time systems, stability on the z-plane and the Jury stability criterion, sample-and-hold systems, practical aspects of choice of sampling rate. **Z-domain description of** sampled continuous-time plants and systems with dead-time, Implementation of digital controllers.

10 Hrs.

## UNIT-II

**Design of Digital Control Algorithms:** z-plane specifications of control system design, digital compensator design using root locus plots and Bode diagrams, z-plane synthesis.

10 Hrs.

## UNIT-III

**Digital Control System Analysis in State-space:** State descriptions of digital processors, state descriptions of sampled continuous-time plants, state descriptions of systems with dead-time, solution of state difference equations, controllability and observability.

10 Hrs.

## UNIT-IV

**Digital Control System with State Feedback:** State regulator design, design of state observers, compensator design by separation principle, servo design, state feedback with integral control, deadbeat control by state feedback and deadbeat observers.

10 Hrs.

## Course Outcomes:

Students will:

- CO1: Configure digital control system.
- CO2: Describe digital control system in z-domain.
- CO3: Design digital control algorithms.
- CO4: Analyze digital control system in state space.
- CO5: Model digital control system.
- CO6: Design digital controller and apply them in real process.

## Text Books:

1. M.Gopal, "Digital Control and State Variable Methods", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2009.

## Reference Books:

1. Benjamin C. Kuo, "Digital Control Systems", 4<sup>th</sup> Edition, Oxford University Press, 1992
2. K. Ogata, "Discrete-Time Control Systems", 2<sup>nd</sup> Edition, PHI.

# UEI874E:OPTIMIZATION TECHNIQUES

3 Credits (3-0-0)

## Course Objectives:

1. To explain the fundamental concepts of optimization techniques.
2. To introduce the problem and classification of optimization
3. To discuss the methods of constrained minimization.

## UNIT-I

**Introduction to Optimization:** Engineering applications of optimization, optimization problem-design vector, design constraints, constraint surface, objective function, objective function surfaces, Classification of optimization problems- based on the existence of constraints, the nature of the design variables, the physical structure of the problem, the nature of the equations involved, the permissible values of the design variables, the deterministic nature of the variables, the separability of the functions, the number of objective functions. Optimization techniques.

10 Hrs.

## UNIT-II

**Classical Optimization Techniques:** Single variable optimization – Multivariable optimization with no constraints – Hessian matrix –Multivariable saddle point – Optimization with equality constraints – Lagrange multiplier method -Multivariable optimization with inequality constraints – Kuhn-Tucker conditions.

10 Hrs.

## UNIT-III

**One-dimensional Unconstrained minimization:** Elimination methods – unrestricted search method – Fibonacci method – Interpolation methods –Quadratic interpolation and cubic interpolation methods.

10 Hrs.

## UNIT-IV

**Unconstrained minimization:** Gradient of a function – Steepest descent method – Newton's method – Powells method – Hooke and Jeeve's method.

10 Hrs.

## Course Outcomes:

Students will:

- CO1: Posses the knowledge of fundamental concepts of optimization techniques.
- CO2: Identify engineering application of optimization.
- CO3: Classify optimization techniques.
- CO4: Identify the problem.
- CO5: Demonstrate constrained minimization.
- CO6: Demonstrate unconstrained minimization.

## Text Books:

1. S.S. Rao, "Optimization theory and application", 3<sup>rd</sup> Edition, New Age International Pvt. Ltd.

## Reference Books:

1. A. D. Belegundu, T.R. Chandrupatla, "Optimization Concepts and Applications in Engineering", Pearson Education Asia.

# UEI881E: DATABASE MANAGEMENT SYSTEMS

3 Credits (3-0-0)

## Course Objectives:

1. To highlight the concepts of database management system.
2. To give insight of data modeling, entity relationship and ER diagrams.
3. To discuss the concepts of relational data model and relational algebra and SQL.

## UNIT-I

**Introduction:** Characteristics of database approach; advantages of using DBMS approach; when not to use a DBMS. Data models, schemas and instances; Three schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client server architectures; Classification of Database Management systems. **Entity Relationship Model:** Using high-level conceptual data models for database design; An example database application; Entity types, Entity sets, Attributes and Keys; Relationship types, Relationship sets, Roles and Structural constraints; Weak entity types; Refining the ER Design; ER Diagrams, Naming conventions and design issues; Relationship types of degree higher than two.

10 Hrs.

## UNIT-II

**Relational Model and Relational Database Constraints:** Relational model concepts; Relational model constraints and Relational database schemas; Update operations, Transaction and dealing with constraint violations. **Relational Algebra:** Unary relational operations: SELECT and PROJECT Relational algebra operations from set theory; Binary relational operations: JOIN and DIVISION; Additional relational operations; Examples of queries in relational algebra; Relational database design using ER to Relational mapping. **SQL:** data definition and data types; Specifying basic constraints in SQL; Schema change statements in SQL; Basic queries in SQL.

10 Hrs.

## UNIT-III

**Database Design:** Informal design guidelines for relation schemas; Functional dependencies; Normal forms based on primary keys; General definitions of second and third normal forms; **Properties of Relational Decompositions;** Algorithms for relational database Schema design.

10 Hrs.

## UNIT-IV

**Transaction Management:** Introduction to transaction processing; Transaction & system concepts; Desirable properties of transactions; Characterizing schedules based on recoverability; Characterizing schedules based on serializability. **Concurrency Control:** Two phase locking techniques for concurrency control. **CRASH recovery:** Recovery concepts; Recovery techniques based on deferred update; recovery techniques based on immediate update; shadow paging; The ARIES recovery algorithm.

10 Hrs.

## Course Outcomes:

Students will:

- CO1 : Identify, analyze and define database objects, enforce integrity constraints on a database.
- CO2 : Analyze and develop relational models, relational algebra concepts & ER diagrams.
- CO3 : Demonstrate the Structured Query Language (SQL) in the design of database systems.
- CO4 : Design and build simple real-world database systems and applications using GUI.
- CO5 : Implement normalization algorithms using database design theory for different applications.
- CO6 : Analyze and implement transaction processing, concurrency control and database recovery.

## Text Books:

1. Ramez Elmasri & Shamkant B. Navathe, "Fundamentals of Database Systems", 5<sup>th</sup> Edition, Pearson Education.

**Reference Books:**

1. Ramakrishanan Gehrke, “ Database Management Systems”, 3<sup>rd</sup>Edition, McGraw Hill Higher Education.
2. C. J. Date, “An Introduction to Data base systems”, Addison Wesley, 4<sup>th</sup> Edition.

# UEI882E:AIRCRAFT INSTRUMENTATION

3 Credits (3-0-0)

## Course Objectives:

1. To describe the basics of Aircraft and instrumentation involved in aircraft systems.
2. To discuss about the measurement of various aircraft parameters.  
To explain the techniques for measurement of fuel quantity and engine control instrument.

## UNIT-I

**Introduction:** Aircraft types, Components of airplane, Introduction to the aircraft instruments, Classification of aircraft instruments, Basic “T” grouping of instruments, Instrument displays, Cockpit layout. **Theory of Air Data Instruments:** Pneumatic type and air data computers, International standard atmosphere (ISA), Basic pneumatic air data system, Combined pitot-static probe.

10 Hrs.

## UNIT-II

**Air Data Instruments:** Air speed indicator, Machmeters, Altimeters, Instantaneous vertical speed indicator. **Directional Systems:** Earth’s total magnetic field, Horizontal and vertical components of total field direct reading compass and its limitations, Total magnetic effect. **Air Data Warning System:** Mach warning system, Altitude alerts system, Airspeed warning system.

10 Hrs.

## UNIT-III

**Gyroscopic Flight Instruments:** Basic mechanical gyro and its properties: Rigidity and Precision, limitations of a free gyroscope, Methods of operating gyroscopic flight instruments, Gyro horizon principle, Erection systems for gyro horizons, Direction indicator, Turn and bank indicator, Turn coordinator.

10 Hrs.

## UNIT-IV

**Engine Instruments:** Pressure measurement, Temperature measurement, Capacitance type volumetric fuel quantity indicator, Densitometer, Fuel quantity indicator by weight, EPR, EGT, Integrated impellor type flow meter.

10 Hrs.

## Course Outcomes:

Students will:

- CO1: Identify and list various engineering components of an aircraft.
- CO2: Describe general instrumentation of aircraft.
- CO3: Compare the working of air data, engine and power plant instruments of an aircraft.
- CO4: Interpret the atmosphere for aircraft and instruments for air data, power plant, and engine of an aircraft.
- CO5: Distinguish the functionality of air data instruments from other instrumentation.
- CO6: Analyze instrumentation system of an aircraft.

## Text Books:

1. EHJ Pallet, “Aircraft Instruments and Integrated Systems”, Longman Scientific & Technical, 1992.

## Reference Books:

1. C A Williams, “Aircraft Instruments”, Galgotia Publications, New Delhi.
2. Bhaskar Roy, “Aircraft Propulsion”, Elsevier Publications, New Delhi.

# UEI883E: ADVANCED INDUSTRIAL AUTOMATION

## 3 Credits (3-0-0)

### Course Objectives:

1. To impart the importance and benefits of automation
2. To make use of analog PLC for industrial automation.
3. To discuss the fundamentals of industrial buses and network topologies.

### UNIT-I

**Advanced PLC Functions:** Analog PLC operation, PID control of continuous processes Networking PLCs, Alternative programming languages, PLC auxiliary commands and functions, PLC Installation, Troubleshooting, and maintenance, Selecting a PLC. **Advanced automation:** Classical approaches of plant automation, Computer-based plant automation concepts, Distributed Computer Control.

10 Hrs.

### UNIT-II

**System Architecture:** Evolution of hierarchical system structure, Functional levels, Database organization, System implementation concepts, Human interface. **System Elements of Distributed Computer Control:** Field stations, Intermediate stations, Central computer station, Monitoring and command facilities.

10 Hrs.

### UNIT-III

**Industrial Networking:** Introduction, Hierarchy of Industrial networks, Network topologies, Data flow management, Transmission hardware, Network backbones, Network communication standards, Fieldbus networks, Modbus, AS-Interface, HART, Foundation Fieldbus, Profibus, NetLinx networks, DeviceNet, ControlNet. Ethernet/IP

10 Hrs.

### UNIT-IV

**Application Development and Automation for Industry Verticals:** Water and Waste Water Treatment, Cement, Pulp and paper plant, Glass making plant, Oil and gas fields.

10 Hrs.

### Course Outcomes:

Students will:

- CO1: State aims of plant automation.
- CO2: Identify the different levels of industrial automation.
- CO3: Illustrate the operations of analog PLC and differentiate between discrete and analog PLC.
- CO4: Compare classical and computer based approaches for plant automation.
- CO5: Interpret the evolution of hierarchical system architecture.
- CO6: Apply the automation concepts and methods to process industries.

### Text Books:

1. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5<sup>th</sup> Edition, PHI Publication.
2. Poppovik, Bhatkar, "Distributed Computer Control for Industrial Automation", Dekkar Publications.
3. Terry Baltelt, "Industrial Automated Systems: Instrumentation and Motion Control", Delmar Cengage Learning, 2011.

### Reference Books:

1. S. K. Singh, "Computer Aided Process Control", PHI Publication.
2. Garry Dunning, "Introduction to Programmable Logic Controllers", Thomson Learning.

# UEI884E: PATTERN RECOGNITION

3 Credits (3-0-0)

## Course Objectives:

1. To equip with basic mathematical and statistical techniques commonly used in pattern recognition.
2. To introduce to a variety of pattern recognition algorithms.
3. To provide a detailed overview of some advanced topics in pattern recognition.

## UNIT-I

**Introduction:** Pattern Recognition (PR) overview, pattern recognition typical system, classification, patterns & features extraction with examples, Design cycles, Training, learning and adaptation, Pattern recognition approaches. Statistical decision theory. Probability: Introduction, probability of events, random variables, joint distributions and densities, moments of random variables, estimation of parameters from samples, minimizing risk estimators. **Statistical Decision Making:** Introduction, Bayes theorem, multiple feature, conditionally independent feature, decision boundaries, unequal costs of error, estimation of error rates the leaving one out technique, characteristic curves, estimating the composition of populations.

10 Hrs.

## UNIT-II

**Non-parametric Decision Making:** Introduction, histograms kernel & window estimate or nearest neighbor classification techniques, adaptive decision boundaries. **Clustering:** Introduction, hierarchical clustering, partitioned clustering. Formulations of unsupervised learning problems, Clustering for Unsupervised Learning and classification

10 Hrs.

## UNIT-III

**Syntactic Pattern Recognition:** Overview, quantifying structure in pattern description and recognition, grammar based approach, elements of formal grammar. Structural Recognition via Parsing and other grammars; Graphical approaches to syntPR. Learning Via Grammatical inference. Neural Pattern Recognition: Introduction to neural networks, Neural network for PR applications, Physical neural networks, Artificial neural network model. Introduction to neural pattern associators and matrix approaches and examples.

10 Hrs.

## UNIT-IV

**Feed-forward Networks and Training by Back Propagation:** Introduction, Multilayer, Feed-forward structure, Training the feed-forward network, Examples, Unsupervised Learning in NeurPR: Hopfield approach to neural computing, Examples.

10 Hrs.

## Course Outcomes:

Students will:

- CO1: Design systems for pattern recognition.
- CO2: Design algorithms for pattern recognition.
- CO3: Interpret the classification problems.
- CO4: Quantify structure in pattern description and recognition.
- CO5: Apply parameter estimation in relatively complex probabilistic models.
- CO6: Apply decision making in relatively complex probabilistic models.

## Text Books:

1. Earl Gose, "Pattern Recognition and Image analysis", PHI, 2002.
2. Robert Schalkoff, "Pattern Recognition: Statistical, structural and Neural Approaches", John Wiley and Sons, Inc. 1992.

## Reference Books:

1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", John Wiley and Sons, Inc 2<sup>nd</sup> Edition, 2001.

# UEI891E: LASERS AND FIBER OPTICS

## 3 Credits (3-0-0)

### Course Objectives:

1. To learn the different lasers.
2. To know the application of lasers in different fields.
3. To discuss the fundamentals of optical fibers and optical sensors.

### UNIT-I

**Fundamentals of Lasers:** Emission and absorption of radiation, Einstein relations, population inversion with 2 level, 3 level and 4 level energy systems, optical feedback, line shape functions, laser losses, threshold conditions, laser modes, properties of laser light, classification of lasers, **Doped Insulator Lasers:** Nd:YAG laser, Ruby laser.

10 Hrs.

### UNIT-II

**Semiconductor Lasers:** Basics, threshold current density for semiconductor lasers, hetero junction lasers. **Gas, ion and molecular Lasers:** Gas lasers: Atomic lasers- He-Ne laser, Ion laser-Argon laser, Molecular laser-CO<sub>2</sub> laser, Liquid dye lasers, mode locking- Introduction, active & passive mode locking, Q-switching- Introduction, methods of Q-switching- Rotating mirror method, Electro-optic method, Passive method.

10Hrs.

### UNIT-III

**Optical Fibers:** Introduction, fiber benefits, structure of fiber, propagation of light in fibers, principles of fiber optics, fiber specifications, types of fiber: step index fiber, graded index fiber, multimode and single mode fiber, optical fiber materials, **Optical sources & Detectors:** Principle & constructional details of LED. Photo diode, PIN diode, avalanche diode, and Photo transistor. (Working principles only).

10 Hrs.

### UNIT-IV

**Laser applications:** Measurement of distance - Interferometric methods, beam modulation telemetry, pulse echo techniques. Holography-principle, holographic computer memory system. **Optical fiber sensors:** Phase and polarization fiber sensors, ring with multiround fiber coil, optical fluid level detector, optical fiber flow sensors, optical displacement Moiré fringe modulation sensors, current measurement by single mode optical fiber sensors, fluoro-optic temperature sensors, photo elastic pressure sensors, laser Doppler velocimeter using optical fiber.

10Hrs.

### Course Outcomes:

Students will:

- CO1: Describe the fundamental concepts of laser and optical instruments.
- CO2: Define various principles of laser and optical instruments.
- CO3: Describe techniques employed in laser and optical instruments.
- CO4: Depict the applications of laser and optical instruments.
- CO5: Apply the governing laws and modes in laser and optical instruments.
- CO6: Differentiate /categorize various laser and optical instruments..

### Text Books:

1. Wilson and Hawkes, "Optoelectronics: An Introduction," 2<sup>nd</sup> Edition, Prentice-Hall of India, 2001.
2. C.K.Sarkar and D.C. Sarkar, "Optoelectronics and Fiber Optics Communication," New Age Int. Pub., 2004.
3. P.Sarah, I.K., "Lasers and Optical Fiber Communications," International Publishing House Pvt. Ltd., 2008.

### Reference Books:

1. Wilson & Hawkes, "Laser Principles and Applications," 2<sup>nd</sup> Edition, PHI.
2. Orazio Svelto, "Principles of Lasers," 5<sup>th</sup> Edition, Springer.

# UEI892E: INSTRUMENTATION SYSTEM DESIGN

## 3 Credits (3-0-0)

### UNIT-I

**Design of pick-up circuits and transmitters :** Design of V/I Converter and I/V Converter- Analog and digital filter design, Design of signal conditioning circuit for pH measurement, Temperature measurement – Compensation circuit, Signal conditioning circuit, Cold junction compensation – software and hardware approaches, Thermocouple linearization – software and hardware approaches.

**10 Hrs.**

### UNIT-II

**Design of transmitters:** RDT based temperature transmitter, Thermocouple based temperature transmitter, Design of capacitance based level transmitter, Design of smart flow transmitters. **Design of data loggers:** Microcontroller based data logger, Design of PC based data acquisition cards.

**10Hrs.**

### UNIT-III

**Flow system:** Design of orifice, Rotameter, Venturi meter and their signal conditioning circuits. **Level:** Design of level sensors and its signal conditioning circuits **Pressure:** Design of pressure gauge, Diaphragm based pressure gauge, Load cell and its signal conditioning, Study of P/I and I/P converters, Design of smart transmitters. **Design of alarm and annunciation circuit:** Alarm and annunciation circuits using analog and digital Circuits

**10 Hrs.**

### UNIT-IV

**Reliability:** Concept, Definition, Distinction between Quality and reliability, Failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modeling Exponential, Weibull and Gamma Distribution, Hazard rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function and Reliability, function system Transition Diagrams and Markov Chain modeling concurrent and sequential systems. Component and Operational Modes. Reliability Prediction: Life Testing and Accelerated Life testing Burn-in and Initial failure removal.

**10Hrs.**

### Reference Books:

1. Warren Boxleitner, “Electrostatic Discharge and Electronic Equipment”, IEEE press.
2. C. D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Prentice Hall, 2006.
3. R.W. Miller, “Flow Measurement Engineering Handbook”, Mc-Graw Hill, New York 1996.

## **UEI893E: NON-DESTRUCTIVE TESTING**

**3 Credits (3-0-0)**

### **UNIT-I**

**Introduction:** Principle, Need & benefits of NDT, Quality of inspection, Classification, **Liquid penetrant technique:** Principle, Penetrant characteristics, Types of penetrant systems, Procedure description, Advantages, Limitations & applications.

**10 Hrs.**

### **UNIT-II**

**Ultrasonic testing:** Generation of ultrasound, Characteristics of an ultrasonic beam, Inspection techniques, Identification of defects, Immersion testing, Applications. **Radiographic testing:** Principle, Uses & limitations of radiography, Radiation sources, Xeroradiography, Fluoroscopy, Exposure factors, Identification markers & image quality indicators, Radiation safety.

**10Hrs.**

### **UNIT-III**

**Magnetic testing:** Magnetization, Magnetic particles, Magnetization methods, Continuous & residual method, Sensitivity, Advantages, limitations and applications. **Electrical / Eddy current testing:** Principle, Variables involved during inspection, Inspection frequency, Inspection probes, Eddy current test circuits and applications

**10 Hrs.**

### **UNIT-IV**

**Other testing methods:** Optical inspection probes, Neutron radiography, Acoustic emission inspection, Thermo grapy, Surface texture analysis, Multi – phase flow analysis, Laser induced ultrasonic, Time of flight diffraction (TOFD).

**10Hrs.**

### **Text Books:**

1. B.Hull & V. John, “Non-Destructive Testing”, 1989, ELBS.
2. R.Halmshaw, “Non-Destructive Testing”, Second Edition, Butterworth Heineman, 1991

## **UEI894E: PRODUCT DESIGN**

**3 Credits (3-0-0)**

### **UNIT-I**

**Introduction, development process and organizations:** Characteristics of successful product development, Duration and cost of product development. **Generic development process - concept development:** Front-end process, Adapting the generic product development process

**10 Hrs.**

### **UNIT-II**

**Identifying customer needs and establishing product specifications:** Defining scope, Gathering data from customers, Establishing relative importance of needs, Target specifications & refining specifications. **Concept generation:** Five-step methodology of concept generation with simple example

**10Hrs.**

### **UNIT-III**

**Human engineering considerations in product design:** Anthropometry, Design of controls and displays, Man/machine information exchange. **Concept embodiment:** Basic methods, Advanced methods, Case study-CRO with reference to ergonomics and aesthetics

**10 Hrs.**

### **UNIT-IV**

**PCB TECHNOLOGY:** Introduction, types, applications, base materials, design methods and fabrication processes

**10Hrs.**

### **Text Books:**

1. Karl T Ulrich, Steven D Eppinger, "Product Design and Development", Tata McGraw Hill - 3<sup>rd</sup> Edition.
2. Walter C Boshart, "Printed Circuit board Design and Technology", McGraw Hill International.

### **Reference Books:**

1. K. Chitale and RC Gupta, "Product Design and Manufacturing", Prentice Hall.
2. Kevin Otto, Kristin Wood, "Product Design", 2nd Edition, Pearson Education.