# Course Scheme for Post Graduate Programme

# in

# Instrumentation and Control Engineering



# Department of Electrical & Instrumentation Engineering

# Sant Longowal Institute of Engineering & Technology
# Longowal-148106
# Phone: 01672-253119/253120 Fax: 01672-280057
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# Vision of Department

Electrical and Instrumentation Engineering department shall strive to act as a podium for the development and transfer of technical competence in academics, entrepreneurship and research in the field of Electrical and Instrumentation Engineering to meet the changing needs of society.

## MISSION

1. To provide modular programmes from skill development to the research level
2. To impart Education and training in innovative state-of-the-art technology in the field of Electrical and Instrumentation Engineering.
3. To promote holistic development among the students
4. To provide extension services to rural society, industry professionals, institutions of research and higher learning in the field of Electrical and Instrumentation Engineering.
5. To interact with the industry, educational and research organizations, and Alumni in the fields of curriculum development, training and research for sustainable social development and changing needs of society.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO):

The following Programme Educational Objectives are designed based on the department mission. The post-graduates of Instrumentation and Control Engineering should be able to:

1. Extract knowledge through literature survey, experimentation, expertise in research methodology, technique and tools.
2. Utilize, expertise in designing and analysing complex and real life problems that are techno-economically and socially sustainable.
3. Demonstrate professional ethics and commitment to organizational goals.
4. Demonstrate Leadership and team work while working with diverse multi-disciplinary/interdisciplinary groups.
5. Exhibit sustained learning and adaptation to modern engineering tools, techniques and practices through instruction, group activity and self-study.

## PROGRAMME OUTCOMES (PO):

**Instrumentation and Control Engineering Post-graduates will be able to:**

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAMME SPECIFIC OUTCOMES (PSO)

1. Apply knowledge to design, analyze and synthesize problems related to Instrumentation and Control Engineering.
2. To evolve innovative solutions for real-time and industrial problems using skills, modern tools and recent technologies.

# SCHEME
## of
# Master of Technology Instrumentation and Control Engineering

## M.TECH. (CONTROL AND INSTRUMENTATION ENGINEERING)

| S. No. | Subject Code | Subject Name | L | T | P | Hrs. | Credits |
|---|---|---|---|---|---|---|---|
| **Semester-I** | | | | | | | |
| 1 | PCIE-811 | Instrumentation System Design | 3 | 0 | 0 | 3 | 3 |
| 2 | PCIE-812 | Non-Linear and Adaptive Control | 3 | 0 | 0 | 3 | 3 |
| 3 | PEIE-811 | Core Elective-1 | 3 | 0 | 0 | 3 | 3 |
| 4 | PEIE-812 | Core Elective-2 | 3 | 0 | 0 | 3 | 3 |
| 5 | CCIE-811 | Research Methodology and IPR | 2 | 0 | 0 | 2 | 2 |
| 6 | ACIE-811 | English For Research Paper Writing and Professional Communication | 2 | 0 | 0 | 2 | 0 |
| 7 | PCIE-813 | Instrumentation System Design Lab | 0 | 0 | 4 | 4 | 2 |
| 8 | PCIE-814 | Modelling and Simulation Lab–I | 0 | 0 | 4 | 4 | 2 |
| | | **Total** | **16** | **0** | **8** | **24** | **18** |

| Sr. No. | Subject Code | Subject Name | L | T | P | Hrs. | Credits |
|---|---|---|---|---|---|---|---|
| **Semester-II (A)** | | | | | | | |
| 1 | PCIE-821 | Industrial Process Control | 3 | 1 | 0 | 4 | 4 |
| 2 | PCIE-822 | Advanced Bio-Medical Instrumentation | 3 | 0 | 0 | 3 | 3 |
| 3 | PEIE-821 | Core Elective-3 | 3 | 0 | 0 | 3 | 3 |
| 4 | PEIE-822 | Core Elective-4 | 3 | 0 | 0 | 3 | 3 |
| 5 | ACIE-821 | Constitution of India | 2 | 0 | 0 | 2 | 0 |
| 6 | PCIE-823 | Advanced Bio-Medical Instrumentation Lab | 0 | 0 | 4 | 4 | 2 |
| 7 | PCIE-824 | Modelling and Simulation Lab–II | 0 | 0 | 4 | 4 | 2 |
| 8 | PCIE-825 | Seminar | 0 | 0 | 2 | 2 | 1 |
| | | **Total** | **14** | **1** | **10** | **25** | **18** |

| | | | | | | Hrs. | Credits |
|---|---|---|---|---|---|---|---|
| **Semester-II (B)** | | | | | | | |
| | | Four weeks training in reputed industry/laboratory in Institutions of repute such as IITs, NITs, CSIR, DRDO, CSIO etc. | | | | 160 | S/US |

| Sr. No. | Subject Code | Subject Name | L | T | P | Hrs. | Credits |
|---|---|---|---|---|---|---|---|
| **Semester-III** | | | | | | | |
| 1 | PEIE-911 | Core Elective-5 | 3 | 0 | 0 | 3 | 3 |
| 2 | OEIE-911 | Open Elective | 3 | 0 | 0 | 3 | 3 |
| 3 | PCIE-911 | Dissertation (Part-1) | 0 | 0 | 20 | 20 | 10 |
| | | **Total** | **6** | **0** | **20** | **26** | **16** |

| Subject Code | Subject Name | L | T | P | Hrs. | Credits |
|---|---|---|---|---|---|---|
| **Semester-IV** | | | | | | |
| PCIE-921 | Dissertation (Part-2) | 0 | 0 | 32 | 32 | 16 |
| | **Total** | **0** | **0** | **32** | **32** | **16** |

**Total Credits: 68**

## LIST OF PROGRAM SPECIFIC/ CORE ELECTIVE COURSES

| CORE ELECTIVE-1 (PEIE-811) | | |
|---|---|---|
| Sr. No. | Subject Code | Subject Name |
| 1 | PEIE-811A | Data Communication |
| 2 | PEIE-811B | Microcontroller and Embedded Systems |
| 3 | PEIE-811C | Instrumentation for Environmental Engineering |
| 4 | PEIE-811D | Power Plant Instrumentation |
| 5 | PEIE-811E | Signal Conditioning and Data Acquisition |
| | | |

| CORE ELECTIVE-2 (PEIE-812) | | |
|---|---|---|
| Sr. No. | Subject Code | Subject Name |
| 1 | PEIE-812A | Random and Stochastic Processes |
| 2 | PEIE-812B | Energy Auditing and Management |
| 3 | PEIE-812C | Power System Stability and Control |
| 4 | PEIE-812D | Neuro Fuzzy Control |
| 5 | PEIE-812E | Optimization Techniques |
| | | |

| CORE ELECTIVE-3 (PEIE 821) | | |
|---|---|---|
| Sr. No. | Subject Code | Subject Name |
| 1 | PEIE 821A | |
| 2 | PEIE 821B | Telemetry and Remote Control |
| 3 | PEIE 821C | Multi Range Signal Processing |
| 4 | PEIE-821D | Industrial Electronics |
| 5 | PEIE-821E | Industrial Internet of Things |
| 6 | PEIE-821F | Digital Signal Processor for Instrumentation |
| | | |

| CORE ELECTIVE-4 (PEIE 822) | | |
|---|---|---|
| Sr. No. | Subject Code | Subject Name |
| 1 | PEIE 822A | Optimal and Robust Control |
| 2 | PEIE 822B | Computational Electromagnetics |
| 3 | PEIE 822C | Control System Design |
| 4 | PEIE-822D | Intelligent Control |
| 5 | PEIE-822E | Machine Learning – An Approach to Artificial Intelligence |
| | | |

| CORE ELECTIVE-5 (PEIE 911) | | |
|---|---|---|
| Sr. No. | Subject Code | Subject Name |
| 1 | PEIE 911A | Microprocessor Applications in Instrumentation |
| 2 | PEIE 911B | Robotics Engineering |
| 3 | PEIE 911C | Opto Electronics and Instrumentation |
| 4 | PEIE-911D | System Identification and Parameter Estimation |
| 5 | PEIE-911E | Artificial Intelligence in Medical Diagnosis |

| OPEN ELECTIVE COURSE (OEIE-911) | | |
|---|---|---|
| Sr. No. | Subject Code | Subject Name |
| 1 | OEIE-911A | Microcontroller and Embedded Systems |
| 2 | OEIE-911B/ PEIE-812B | Energy Auditing and Management |
| 3 | OEIE-911C | Virtual Instrumentation and Data Acquisition |
| 4 | OEIE-911D | Industrial Safety |

| 5 | OEIE-911E | Soft Computing Techniques |
| 6 | OEIE-911F | Medical Image Processing |
| 7 | OEIE-911G | Solar and Wind Power Technologies |
| 8 | OEIE-911G | Instrumentation in Precision Agriculture |

# SYLLABUS
## of
# Master of Technology Instrumentation and Control Engineering

## PCIE-811 INSTRUMENTATION SYSTEM DESIGN

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1:** To comprehend the concept of general measurement system with its functional elements.

**CO2:** Study types of transducers, analyze physical quantities like speed, temperature etc.

**CO3:** Cover a unified treatment of measurement system dynamics.

**CO4:** Emphasis on use of sensors in manufacturing, and material on electro-optical systems.

**CO5:** To develop and display a signal with the application of signal conditioning.

| CO/PO Mapping: (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | W | | | | M | | W | | W | | M | S | W |
| CO2 | S | M | | | M | M | W | W | | | | | S | M | S |
| CO3 | W | | M | | W | | | | | | | W | M | M |
| CO4 | M | M | S | | S | S | W | M | W | W | | M | S | M |
| CO5 | M | M | S | | M | S | W | M | W | M | W | M | M | S |

## Unit I

**Introduction:** Concept of generalized measurement system, functional elements, generalized input-output configuration, static sensitivity, drifts, linearity, hysteresis, threshold, resolution, static stiffness and input-output impedance.

(12 Hrs)

**Transducers (Part-1):** Operating principle, construction and design of variable resistive transducers, variable inductive transducers, variable capacitive transducers, piezoelectric transducers, magnetostrictive transducers, Hall effect, eddy current, ionization, optical transducers, digital transducers, single shaft encoders, photo voltaic cell, photo conductive, photo emissive, fiber optic sensors, concept of smart and intelligent sensor, bio-sensors.

(12 Hrs)

## Unit II

**Transducers (Part-2):** Construction and performance of industrially important transducer for measuring displacement, speed, vibrations, temperature, electrical power, strain, torque force, Design of intelligent instrumentation system.

(12 Hrs)

**Signal Conditioning & Recording:** Quarter, half and full bridge circuit, active filters, differential instrumentation amplifiers, carrier amplifiers, design of display elements, light-emitting diode (LED), bar graph displays, liquid-crystal display (LCDs), nixie tube and their interfacing.

(12 Hrs)

**Recommended Books-**

**Text Books:**

1. E. Doebelin and D. N. Manik, *Measurement systems application and design*, 5th edition, TMH, New Delhi, 2007.
2. Harry N. Nortan, *Hand Book of transducer,*Facsimile edition, PHI, 1989.

**Reference Books:**

1. Douglas M. Considine, *Process/Industrial Instruments and Controls Handbook*, 5th edition, McGraw-Hill, 2009
2. John P. Bentley, *Principles of Measurement Systems*, 3rd edition, Pearson Education India, 2009.

## PCIE-812  NON-LINEAR AND ADAPTIVE CONTROL

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Construct state space models from different methods of controllability and observability.

**CO 2:** Organize the analysis of feedback control systems and features of non-linear system.

**CO 3:** To characterize the Lyapunov's stability properties of state space systems.

**CO 4:** Study of adaptive and control system to maintain a level of performance of control system.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | | S | M | | | | | | | | | | |
| CO2 | | S | | M | | M | | | | | | | | |
| CO3 | | M | S | | | | | M | | | | | | |
| CO4 | | | | S | | | | | M | | | S | | |

## Unit I

**State Variable Analysis and Design:** Review of state space representation for linear continuous system, solution of linear time invariant state equations, controllability and observability.

(12 Hrs)

**Non-Linear Control System:** Introduction to non-linear feedback control system, Common physical non-linearities, special features of non-linear system, limit cycle, jump response, sub harmonics etc., stability of non-linear systems.

(06 Hrs)

**Describing Functions:** Definition, describing function for common physical non-linearities, describing function method for stability analysis, limit cycle and limitations of describing functions. (06 Hrs)

## Unit II

**Phase plane analysis:** Basic concepts of phase plane analysis, Phase portraits and their construction. Singular points & system analysis using phase plane technique.

(06 Hrs)

**Liapunov's Stability Analysis:** Concept of local, globe, asymptotic & total stability of non-linear system, Stability theorems of Liapunov for non-linear system. Liapunov's direct method of stability, Generation of Liapunov's function by Krosovskii's & Variable gradient method; stability theorem for N.L. system.

(06 Hrs)

**Adaptive and Learning Control Systems:** Basic principles of Adaptive and Learning Control Systems, Model reference adaptive control, types of learning-supervised and un-supervised leaning control systems, On-line and off-line learning control systems. (12 Hrs)

**Recommended Books:**

**Text Books:**
1. Benjamin C. Kuo, *Automatic Control System*, 8th edition, John Wiley & Sons, 2002.
2. I. J. Nagrath and M. Gopal, *Control System Engineering*, New Age, 2009.
3. K. Ogata, *Modern Control Engineering*, 5th edition, Prentice Hall (PHI), 2010.

**Reference Books:**
1. Norman S. Nise, *Control System Engineering*, 6th edition, Wiley Publication, 2010.
2. Richard C. Dorf and Robert H. Bishop, *Modern Control System*, 12th edition, Addison –Wesley, Pearson,  New Delhi, 2011.

# PEIE-811A   DATA COMMUNICATION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1:** Develop data transmission concepts and types of transmission ~~medium~~ media.

**CO2:** Understand Encoding, modulation of signals, concept of digital data communication.

**CO3:** Exercise multiplexing, types of switching and their various techniques.

**CO4:** Interpret Spread Spectrum, frequency hopping, code division.

**CO5:** Implement error detection and correction, various architectures for communication.

| | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | | | | | | S | | | | | | M | S |
| CO2 | | | | | | M | | | | M | | M | M | S |
| CO3 | | | | | | S | | M | | | | | M | S |
| CO4 | | M | | | | M | | | | | | | M | S |
| CO5 | | | | | M | | M | | | | | | M | S |

## Unit I

**Introduction:** Basic Concepts of analog and digital signals, data transmission concepts, Analog and digital transmission, transmission impairments.

(06 Hrs)

**Transmission Media:** Guided and Un-guided media, Performance, Shannon Capacity, Media Computerization.

(06 Hrs)

**Encoding and Modulating:** Digital–to-Digital conversion, Analog ~~and~~ to digital conversion, Digital to Analog conversion, Analog to Analog conversion.

(06 Hrs)

**Digital Data Communication:** Digital data transmission, data circuit-terminating equipment (DTE) – data terminal equipment (DCE) Interface, EIA-449 (RS-449), EIA-530, X.21, Modems, Cable Modems. (06 Hrs)

## Unit II

**Multiplexing And Switching:** FDM, WDM, TDM, Multiplexing applications - telephone systems, DSL, Packet Switching & Message switching virtual circuits.

(06 Hrs)

**Spread Spectrum:** Concept, Frequency hopping spread spectrum, direct sequence spread spectrum, code division Multiple Access.

(06 Hrs)

**Error Detection and Correction:** Types of Errors, Detection, Vertical Redundancy Check (VRC), Longitudinal Redundancy Check (LRC), cyclic redundancy check (CRC), Checksum, Error Correction.

(06 Hrs)

**Protocol Architecture:** Protocols, Standards, Open Systems Interconnection (OSI), TCP/IP Protocol Architecture.

(06 HRS)

**Recommended Books:**

**Text Books:**

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, 5th Edition, PHI, 2010.
2. Black and Ulylers D, *Data Communication and Distributed Networks*, PHI, 1999.

**Reference Books:**

3. Behrouz A Ferouzan, Data Communication and networking, McGraw-Hill, 2007.
4. William Stallings, Data and Computer Communication, Pearson Education, 2007.

## PEIE-811B   MICROCONTROLLER AND EMBEDDED SYSTEMS

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO1:** Learn basics of Microprocessor, Micro-controllers and study 8051 micro-controller architecture.
**CO2:** Understand the basic programming and create basic assembly language programs.
**CO3:** Demonstrate the design of 8051 Microcontroller, memory details, subroutines and serial data.
**CO4:** Identify analysis and implement the application of microcontroller and the simulators used for this purpose.
**CO5:** Examine practical design implementation using programmable logic device (PLD) and FPGA- architecture.

| | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | | | | | | S | | | | | | M | S |
| CO2 | | | | | | M | | | | M | | M | M | S |
| CO3 | | | | | | S | | M | | | | | M | S |
| CO4 | | M | | | | M | | | | | | | M | S |
| CO5 | | | | | M | | M | | | | | | M | S |

## Unit I
**Introduction:** Microprocessor, Micro-controllers and their comparison, Embedded System.
(06 Hrs)
**The 8051 Architecture:** Introduction, 8051 micro-controller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts.
(06 Hrs)
**8051 Assembly Language Programming:** The mechanics of programming, assembly language programming process, Instruction set (data moving, logical operations, arithmetic operations jump and call instructions), Addressing Modes.
(12 Hrs)

## Unit II
**8051 Microcontroller Design:** Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding I/O, memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, serial data transmission
(12 Hrs)
**Microcontroller Applications:**  Interfacing keyboards, displays, Introduction to the use of assemblers and simulators, Interfacing with LEDs, Seven Segment, Sensors, Basic concepts of LCD, ADC, DAC, Relays etc. and their interfacing to microcontroller.
(06 Hrs)
**PIC Microcontrollers:** Introduction to 16 and 18F families, Architecture and programming, TIMERS and Counters, Interrupts, SPI, I2C, I/O programming and interfacing.
(06 Hrs)

**Recommended Books:**
**Text Books:**
1. John B. Peatman, *Design with Microcontroller*, Prentice Hall, 1997.
2. Kenneth J. Ayola, *The 8051 Micro Controller- Architecture, Programming and Application*, 2nd edition, Thomson Delmar Learning, 1996.

**Reference Books:**

1. A.K. Ray and K.M. Bhurchandi, *Advanced Microprocessors & Peripherals: Architecture, Programming & Interfacing*, TMH, 2006.
2. Muhammad Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Micro-controller & Embedded system*, Pearson Education, 2007.
3. V. Udayashankara and M.S. Mallikarjunaswamy, *8051-Microcontroller: Hardware, Software and Applications*, 1st edition, Tata McGraw Hill, Pvt. Ltd. New Delhi, 2009.

## PEIE-811C    INSTRUMENTATION FOR ENVIRONMENTAL ENGINEERING

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO1:** Learn the types of pollution and their effects on living organisms.
**CO2:** Analyze how the pollution affects economy of a country.
**CO3:** Interpret the harmful effects of air, water, noise pollution and rules set up for their control.
**CO4:** Understand Industrial pollutants and their treatment mechanism as per the Indian Standards.
**CO5:** Examine types of pollution control used in various industries.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | | | | | M | S | | | | | M | M | S |
| CO2 | | M | | | | M | S | | | | | M | M | S |
| CO3 | | | | M | S | | M | | M | | | | M | S |
| CO4 | M | | | | | M | | | | | | | M | S |
| CO5 | | | M | S | M | | M | | | | | M | M | S |

## Unit I

**Introduction:** Source and classification of Air Pollution, Effect of Air Pollution in Human Health, Effect of Air Pollution on Animals, Effect of Air Pollution on Plants.

(12 Hrs)

**Economic Effect and Control of Pollution:** Economic Effects of Air Pollution, Control of Air Pollution by Equipment, Control of Air Pollution by Process Changes, Air Pollution from Major Industrial Operations, Air Pollution legislation and regulation, Environment Protection Act, Air Pollution in Indian cities, Water & Noise Pollution & its control, Green House effects & its control. (12 Hrs)

## Unit II

**Pollution Control for Specific Pollutants:** Industrial Pollution Emission and Indian Standards, Analysis of Pollutants, Control of Biochemical oxygen demand (BOD), Removal of Chromium, Removal of Mercury, Removal of Ammonia / urea, Treatment of Phenolic Effects, Removal of particular matter, Removal of Sulphur Dioxide, Removal of Oxides of Nitrogen, Removal of Vapour from Efficient case, Control of $CO_2$ and CO gases.

(12 Hrs)

**Pollution Control in Selected Process Industries:** General considerations of Pollution Control in Chemical Industries, Pollution Control aspects of fertilizer industries, Pollution Control in Petroleum & Petrochemical Units, Pollution Control in Pulp & Paper Industries, Tanning Industries, Sugar Industries, Alcohol Industries, Electroplating & Metal Finishing Industries, Radioactive Wastes, Pollution Control methods used in Power Plants.

(12 Hrs)

**Recommended Books:**
**Text Books:**
1. G.R. Chhatwal M. Satake,M.C. Mehra,Mohan Katyal,T. Katyal and T. Nagahiro, *Environmental Air Pollution & its control*, Anmol Publication, 2005.
2. S P Mahajan*, Pollution control in Process industries*, McGraw Hill, 1987.
**Reference Books:**
1. H.V. Rao and M.N Rao, *Air Pollution*, McGraw-Hill, 1990.
2. G.R. Chhatwal M. Satake,M.C. Mehra,Mohan Katyal,T. Katyal and T. Nagahiro, *Environmental Water Pollution & its control*, Anmol Publication,1989.

## PEIE-811D    POWER PLANT INSTRUMENTATION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1:** Learn the need &various sources of power, types of power plants and energy scenario in India.
**CO 2:** Analyze features of Hydro plant, its turbine types and speed governing techniques.
**CO 3:** Understand Steam power plants, its components, the turbine classification and governing.
**CO 4:** Develop basics of Nuclear Power plant, reactor types, advantages and disadvantages.
**CO 5:** Identify need of measurement & instrumentation in power plants for study of gas, smoke.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | S | - | M | M | S | S | M | M | S | M | S | M | M |
| CO2 | M | S | - | M | M | S | S | M | M | S | M | S | M | M |
| CO3 | M | S | - | M | M | S | S | M | M | S | M | S | M | M |
| CO4 | M | S | - | M | M | S | S | M | M | S | M | S | M | M |
| CO5 | M | S | - | M | M | S | S | M | M | S | M | S | M | M |

## Unit I
**Introduction:** Resources and development of power in India, various types of power plants, present energy scenarios in India.

(06 Hrs)

**Hydro-Power Plant:** Hydrology, site selection for hydroelectric power plant, essential features/elements of hydroelectric power plant, classification, hydro turbines, governing of hydroelectric turbines.

(06 Hrs)

**Steam power plant:** Classification, fuel handling, combustion equipment's for steam boilers, classification of boilers and their accessories, ash handling, steam turbines, classification, advantages, steam turbine governing and control, feed water treatment for steam power plant.

(12 Hrs)

## Unit II
**Nuclear Power Plant:** Element and layout of Nuclear power plant, Generation of Nuclear energy by fission, Nuclear reactor, Types and the applications, Nuclear waste and its disposal.

(10 Hrs)

**Plant Instrumentation:** Significance of measurement and instrumentation in electric power plant, Analysis of impurities in feed water and steam, Dissolved oxygen analyser, Carbon dioxide analyser, Flue gas oxygen analyser, Pollution monitoring instruments, Smoke density measurement, Dust monitor. (8Hrs)

**Control Loops in Boiler:**
Combustion control – Air/fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temperature control – Super heater control – Air temperature – Deaerator control – Distributed control system in power plants – Interlocks in boiler operation.

(6 Hrs)

**Recommended Books:**
**Text Books:**
1. Mahesh Varma, *Power Plant Engineering*, Book Company Metropolitan, 1976.
2. P.K. Nag, *Power Plant Engineering*, Tata McGraw Hill, 2001.
3. R.K Rajput, *A Textbook of Power Plant Engineering*, 4th Edition, Laxmi Publishers, 2015.
**Reference Books:**
1. S.M. Elonka and A.L. Kohal, *Standard Boiler Operations*, Tata McGraw Hill, New Delhi,1994.
2. Kenneth.C Lish, *Nuclear Power Plant System and Equipment*, Industrial Press, 1972.
3. E.Al. Wakil, *Power Plant Engineering*, Tata McGraw Hill, 1984

## PEIE-811E    SIGNAL CONDITIONING AND DATA ACQUISITION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1:** Understand the need of signal conditioning and data acquisition of any sensor/transducer.

**CO2:** Demonstrate the design of different signal conditioning and data acquisition circuits and explain its advantages and disadvantages.

**CO3:** Identify the components required to design a signal conditioning and data acquisition circuit.

**CO4:** Analyze the benefits of signal conditioning and data acquisition in practical applications.

**CO5:** Design suitable signal conditioning and data acquisition circuit to meet the practical applications.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | M | W | | | M | M | M | S | M | S | S | W | W |
| CO2 | W | S | S | S | S | M | S | S | S | M | S | S | M | M |
| CO3 | S | S | M | S | S | S | S | M | S | M | S | S | S | S |
| CO4 | W | M | W | S | S | S | S | S | S | M | W | S | S | S |
| CO5 | W | S | S | S | S | M | S | S | S | M | S | S | S | S |

## Unit I

**Introduction:** Analog and Digital Signals, Definition of Signal Conditioning and Data Acquisition, Need for Pre-Processing, Block Diagram of Data Acquisition System and Its Applications, Identification of Signal Conditioning Blocks and Their Characteristics, Components of Signal Conditioning Circuit, Components of Data Acquisition Circuit.

(8 Hrs)

**Data Acquisition Systems:** Components of Analog and Digital Acquisition Systems, Single Channel Data Acquisition, Multi-Channel Data Acquisition System, Computer Based Data Acquisition System, Uses of Data Acquisition Systems, Use of Recorders in Digital Systems and Block Diagram of Digital Data Recording System, Data Logging System, Compact Data Logger, Modem Digital Data Acquisition, Digital Transducer.

(8 Hrs)

**Digital to Analog Converters:** Basic DAC techniques, Weighted Resistor DAC, R2R Ladder DAC, DAC 0800 (Data sheet: Features and description only), Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC, ADC 0809 (Data sheet: Features, specifications, and description only), DAC/ADC specifications.

(8 Hrs)

## Unit II

**Signal Conditioning:** Introduction, Types of Signal Conditioning, Classes of Signal Conditioning, Field Wiring and Signal Measurement, Noise and Interference, Minimizing Noise, Shielded and Twisted-Pair Cable.

(6 Hrs)

**Components of Signal Conditioning and Data Acquisition Circuit:** Analysis of DC and AC Bridges, Application of Bridge Circuit for Variable Resistance, Inductance and Capacitance Elements, Bridge Sensitivity and Calibration Circuits. Specifications and Use of Operational Amplifiers for Signal Conditioning Circuits Using Commercial ICs, Characteristics of an Ideal

Operational Amplifiers, Deviation from Ideal Characteristics of Op-Amps., Design of Offset and Drift Compensation Circuits, Frequency Compensation, Specifications and Use of Instrumentation Amplifiers for Signal Conditioning Circuits using Commercial ICs, Necessity for Isolation Amplifiers, Industrial and Medical Applications of Isolation Amplifiers, Grounding and Shielding.

(10 Hrs)

**Design of following configurations:** Inverting Amplifier, Non-Inverting Amplifier, Summer/ Difference Amplifier, Practical Integrator and Differentiator Circuits, Charge Amplifiers and Impedance Converters, Voltage to Current and Current to Voltage Converters, Current Booster for Output Stage, Logarithmic Circuits, Precision Rectifiers, Comparator with and without Hysteresis, Active Filters, Analog Multipliers and PLLs.

(08 Hrs)

**Recommended Books:**
**Text Books:**
1. AK Sawhney, P Sawhney, *A course in Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai & Company, 2016.
2. J Park, AS John Park, S. Mackay, *Practical data acquisition for instrumentation and control systems*, Newnes, 2003.
3. RA. Gayakwad, Op-amps and linear integrated circuits, Prentice-Hall, Inc, 2007.
**Reference Books:**
4. HS Kalsi, *Electronic Instrumentation*, 3e. Tata McGraw-Hill Education; 2018.
5. Robert. F. Coughlin & Fred. F. Driscoll, *Operational Amplifiers and Linear Integrated Circuits*, PHI/Pearson, 2006.
6. James M. Fiore, *Op – Amps and Linear Integrated Circuits*, Thomson Learning, 2001.
7. D. Patranabis, *Principles of Electronic Instrumentation*, PHI Learning Pvt. Ltd, 2008.
8. W. Kester, *Practical design techniques for sensor signal conditioning-bridge circuits*, ch. 2-ch3, Analog Devices. Inc. USA, 1999.

## PEIE-812A RANDOM AND STOCHASTIC PROCESSES

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand the basic aspects of statistics, probability and random processes.

**CO 2:** Analyze the basic concepts of random variable and its properties.

**CO 3:** Comprehend the knowledge of Stochastic Processes and its application to the field of the telecommunication and related problems.

**CO 4:** Apply the concept of statistical estimation.

**CO 5:** Identify the random phenomena incorporating the element of time that are embedded in real-life physical processes in electrical engineering systems.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | | M | S |
| CO2 | S | M | | | | W | | | | | | | M | S |
| CO3 | M | | M | | | | | | | M | | M | M | S |
| CO4 | M | | | | M | | | | | | | | M | S |
| CO5 | S | | | | | | | | | | | | M | S |

## Unit I

**Introduction:** Probability and induction, causality vs. randomness, set theory, probability space, conditional probability, combined experiments, Bernoulli trials, Bernoulli's theorem.

(06 Hrs)

**Random variables:** Distribution and density functions, specific random variables, conditional distributions, function of random variable $g(x)$, distribution of $g(x)$, mean and variance, moments, characteristics functions.

(06 Hrs)

**Two random variables:** Bivariate distributions, one function of two random variables, two functions of two random variables, joint moments, joint characteristics functions, conditional distributions, conditional expected values.

(06 Hrs)

**Sequences of random variables:** Introduction, conditional densities, characteristics functions and normality, mean square estimation, stochastic convergence and limit theorems, random numbers (meaning and generation).

(06 Hrs)

## Unit II

**Stochastic processes:** Definitions, systems with stochastic inputs, power spectrum, discrete time processes, random walks, Poisson points and shot noise, modulation, cyclostationary processes, band limited processes and sampling theory, deterministic signals in noise, bispectra and system identification.

(12 Hrs)

**Spectrum estimation:** Factorizations and innovations, finite order systems and state variables, Fourier series and Karhunen-Loeve expansions, spectral representation of random processes, ergodicity, spectrum estimation, extrapolation and system identification, general class of extrapolation spectra and Youla's parameterization.

(08 Hrs)

**Mean square estimation:** Introduction, prediction, filtering and prediction, Kalman filters.

(04 Hrs)

**Recommended Books:**
**Text Books:**
1. Athanasios Papoulis and S. Unnikrishna Pillai, *Probability, random variables and stochastic processes*, Tata-McGraw Hill.
2. M.H. Hayes, *Probability, random variables and stochastic processes*, John Wiley & Sons.

**Reference Books:**
1. Henry Stark and John W. Woods, *Probability and Random Processes with applications to signal processing*, 3rd edition, Pearson Education, 2002.
2. K. Sam Shanmugan, *Random Signal: Detection, Estimation and Data Analysis*, 1st edition, John Wiley & Sons, 1988.

## PEIE-812B   ENERGY AUDITING AND MANAGEMENT

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1:** Understand the basic aspects of energy audit and management.
**CO 2:** Analyze the basic energy management approach.
**CO 3:** Comprehend the knowledge of energy audit and its application to the field of the various engineering related problems.
**CO 4:** Apply various data gathering and analytical techniques of energy audit.
**CO 5:** Study the Energy Policy Planning and Implementation.

| | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | W | M | | | | S | W |
| CO2 | S | M | | | W | W | | | | M | | | S | W |
| CO3 | M | | M | S | | M | W | | | M | W | M | S | M |
| CO4 | M | M | S | W | M | | | M | S | W | M | | W | S |
| CO5 | S | | W | | | S | M | M | M | M | M | S | M | S |

## Unit I

**Introduction:** General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy.

(04 Hrs)

**Energy Audit:** Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, maximizing system efficiency. Optimizing the input energy requirements, Fuel and Energy substitution.

(04 Hrs)

**Data gathering :** Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

(04 Hrs)

**Analytical Techniques:** Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process, and energy system simulation.

(06 Hrs)

**Evaluation of saving opportunities:** Determining the savings in INR, Noneconomic factors, Conservation opportunities, estimating cost of implementation.

(03 Hrs)

**Energy Audit Reporting:** The plant energy study report- Importance, contents, effective organization, report writing and presentation

(03 Hrs)

## Unit II

**Energy Policy Planning and Implementation:** Force Field Analysis, Energy Policy-Purpose, Perspective, Contents and Formulation. Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivation of employees, Requirements for Energy Action Planning, Designing, Barriers, Strategies,

Marketing and Communicating Training and Planning.

(10 Hrs)

**Energy Balance & MIS:** First law of efficiency and Second law of efficiency, Facility as an Energy system, Methods for preparing process flow, Materials and Energy Balance diagram, Identification of losses, Improvements, Energy Balance sheet and Management Information System (MIS), Energy Modeling and Optimization.

(10 Hrs)

**Energy Audit Instruments:** Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy.

(04 Hrs)

**Recommended Books:**
**Text Books:**
   1. W.R.Murphy, G.Mckay, *Energy Management,* Butterworths.
   2. C.B.Smith, *Energy Management Principles*, Pergamon Press.
**Reference Books:**
   1. *CRC Handbook of Energy Efficiency*, CRC Press.
   2. *Industrial Energy Conservation Manuals*, MIT Press, Mass, 1982.
   3. W.C. Turner, *Energy Management Handbook*, John Wiley and Sons, A Wiley Interscience Publication.

## PEIE-812C   POWER SYSTEM STABILITY AND CONTROL

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Develop small scale model of alternator, excitation, and governing systems.

**CO 2:** Comprehend power system stability.

**CO 3:** Computation of small signal stability.

**CO 4:** Computation of transient stability.

**CO 5:** Computation of voltage stability.

| CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | S | M | M | S | W | - | M | W | M | W | S | M | M |
| CO2 | S | S | M | M | S | W | - | M | W | M | W | S | M | M |
| CO3 | S | S | M | M | S | W | - | M | W | M | W | S | M | M |
| CO4 | S | S | M | M | S | W | - | M | W | M | W | S | M | M |
| CO5 | S | S | M | M | S | W | - | M | W | M | W | S | M | M |

## Unit I

**Introduction to power system stability problems:** Definition of stability, classification of stability, Rotor angle stability, frequency stability, voltage stability, mid-term and long-term stability, classical representation of synchronous machine in a single machine infinite bus system (SMIB), equal area criterion to assess stability of a SMIB system, limitations of classical model of synchronous machines.

(12 Hrs)

**Modeling of power system components for stability analysis:** Synchronous machine modeling: sub-transient model, two axis model, one axis (flux decay) model, classical model. Excitation systems modeling: DC excitation, AC excitation and static excitation. Prime mover and energy supply systems modeling. Transmission line modeling, load modeling. Methods of representing synchronous machines in stability analysis.

(12 Hrs)

## Unit II

**Small signal stability:** Fundamental concepts, state space representation, Modal analysis: Eigen properties, participation factors, stability assessment. Effects of excitation system on stability, power system stabilizer and its design, Angle and voltage stability of multi-machine power systems and phenomenon of sub synchronous resonance.

(08 Hrs)

**Transient stability:** Fundamentals of transient stability, numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability, transient energy function method, Methods of improving transient stability.

(08 Hrs)

**Voltage stability:** Classification of voltage stability, modeling requirements, voltage stability analysis: static and dynamic, sensitivity analysis, modal analysis, voltage collapse, prevention of voltage collapse.

(08 Hrs)

**Recommended Books:**

**Text Books:**
1. P. Kundur, *Power system stability and control*, TataMcGraw Hill.
2. K. R. Padiyar, *Power system dynamics*, BSP publications.

**Reference Books:**
1. M.A. Pai and Peter W. Sauer, *Power system stability*, Pearson Education.
2. M.A. Pai, K. Sen Gupta and K. R. Padiyar, *Topics on small signal stability analysis*, Tata-McGraw hills.
3. Paul M. Anderson and A.A. Fouad, *Power system stability*, Wiley-interscience.

## PEIE-812D NEURO FUZZY CONTROL

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Comprehend the concepts of Fuzzy Sets, Feedback Neural Networks, Fuzzy Logic control and their use for controlling Real Time Systems.

**CO 2:** Know about various fuzzy inference rules and models of approximate reasoning.

**CO 3:** Understand self-learning based methodology for building the rule-base of a fuzzy logic controller (FLC).

**CO 4:** Describe local function approximators and their applications.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | M | | | | | | | | |
| CO2 | S | S | | M | | | | | | | | |
| CO3 | S | | | | | | | | | W | | |
| CO4 | M | | | | M | | | | | | | M |

## Unit I

**Introduction:** Expert systems, fuzzy sets and control theory; representation, reasoning and acquisition; inference engines and functions approximator, model based and training based fuzzy control; neural networks and fuzzy systems; fuzzy-neural control: ideas & para-diagrams.

(12 Hrs)

**Approximate Reasoning Approach:** Introduction, Reasoning models, rule aggregation and operator selection, reasoning with uncertain data and rules, architecture of multivariable fuzzy control.

(12 Hrs)

## Unit II

**Rule Base Construction By Self- Learning:** Description of system structure, proposed learning algorithm, convergence analysis, error and derivative correction, fuzzy control algorithm, extracting rules from recorded data.

(12 Hrs)

**Fuzzy Controller With Self Learning Teacher:** Formulation of the problem, solution using neural networks (BNN network, isomorphic mapping of functionality), Back propagation Neural Network (BNN) based fuzzy controller, learning & rules extracting, hybrid neural network, system structure, dynamical self-organizing, adaptive mechanisms, simplified fuzzy control algorithms, representation and reasoning by CPN, self-construction of rule base, description of the CMAC and RBF, connecting the CMAC and RBF to the SFCA, self-construction of the fuzzified network based controller.

(12 Hrs)

**Recommended Books:**

**Text Books:**

1. J.M. Zurada, *Introduction to Neural systems*, Jaico Publishers.
2. V.B. Rao and H.V. Rao, *Neural Networks & Fuzzy Logic*, BPB Publications.

**Reference Books:**

1. Junhong Nie, *Fuzzy- Neural Control: Principles, Algorithms and Applications*, Prentice Hall.
2. Valluru Rao and Hayagriva V. Rao, *C++ Neural Network and Fuzzy logic*, MIS:Press.

## PEIE- 812E OPTIMIZATION TECHNIQUES

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO1:** Develop the concept of optimization problems.
**CO2:** Analysis of Linear Programming, Transportation problem and Project management procedures
**CO3:** Analysis of unconstrained and constrained optimization problems and their solution procedures
**CO4:** Solution procedure of multi-objective optimization problems
**CO5**: Knowledge about metaheuristic optimization solution procedures

| CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | S | M | M | S | W | W | S | W | M | W | S | S | S |
| CO2 | S | S | M | M | S | W | W | S | W | M | S | S | S | S |
| CO3 | S | S | M | M | S | W | W | S | W | M | W | S | S | S |
| CO4 | S | S | S | M | S | W | W | S | W | M | S | S | S | S |
| CO5 | S | S | S | M | S | W | W | S | W | M | S | S | S | S |

## Unit I
**Optimization Problem:** Definition, types, optimality criteria, classical method. Linear programming: Simplex method and revised simplex method, Duality in Linear Programming Transportation Problem, North-West Corner Rule, Least Cost Method and Vogel approximation method. Critical path method (CPM) and Programme evaluation and review technique (PERT). Dynamic programming,

(12 Hrs)

## Unit II
**Optimization Algorithms:** Scalar variable optimization and Solution Procedure: Exhaustive search, region elimination, Fibonacci search and golden section search, cubic interpolation method, Newton-Raphson bisector and secant method. Multivariable optimization methods: Direct search methods-evolutionary simplex, Hooke-Jeeves pattern search, Gradient Based Method- Steepest method, Newton conjugate gradient method

(12 Hrs)

## Unit III
**Constrained and Multiobjective Optimization:** Karush-Kuhn Tucker condition, transformation methods, penalty function, method of multipliers, sensitivity analysis, interior point optimization. Multi-Objectives Optimization Problems, weighting method, $\in$-constrained method, decision-making, min-max problem, Goal Programming

(12 Hrs)

## Unit IV
**Non-Traditional Optimization:** Metaheuristic optimization Techniques**:** Simulated annealing, Genetic algorithms (Binary and Real) for constrained optimization, Particle swarm optimization, Differential evolution Algorithm. Bat algorithm

(12 Hrs)

**Recommended Books:**

**Text Books:**

1. Kalyanmoy Deb, *Optimization for Engineering Design Algorithms and Examples*, Prentice Hall.
2. Kalyanmoy Deb, *Multi objective Optimization technique using evolutionary algorithm*, Wiley Publication.

**Reference Books:**

1. Singiresu S. Rao, *Engineering Optimization: Theory and Practice*, 3rd Edition, New Age International (P) Limited, Publisher
2. Godfrey C. Onwubolu, *Emerging Optimization Techniques in Production Planning & Control*, Imperial College Press.
3. Yong Hua Song and Kluwer, *Modern Optimization Techniques in Power Systems*, Academic Publishers.

## ACIE-811   AUDIT COURSE-1 (ENGLISH FOR RESEARCH PAPER WRITING AND PROFESSIONAL COMMUNICATION)

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO1:** Understand the Basic Concepts of English Grammar and Sentence Structure
**CO2:** Identify and remove Common Errors of Grammar in Writing **.**
**CO3:** Improve Vocabulary and Writing skills for Paragraph/Essay Writing
**CO4:** Read and Listen to the Comprehension make Precis of given paragraphs
**CO5:** Listen and Speak English Correctly

| Cos | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | S | | | | | | | | | | | | |
| CO2 | | S | | | | | | | | | | | | |
| CO3 | S | S | | | | | | | | | | | | |
| CO4 | | | | | | S | | | | | | | | |
| CO5 | S | S | | | | | | | | | | | | |

### Unit – I
**Interpersonal Skills:** Professional Writing and Speaking Skills to Inform, Propose, and Persuade, Preparing a Case Study about Communication in an Industry

(12 Hrs)

### Unit – II
Planning and Preparation, Removing Redundancy, avoiding Ambiguity and Vagueness, Paraphrasing and Plagiarism

(12 Hrs)

### Unit – III
Identifying an Issue, Conduct Research, Organize Research Findings, and Present an Argument

(12 Hrs)

### Unit – IV
Formal and Informal Communication Styles, Developing PowerPoint Slides, Making an Oral Presentation and Writing e-mail Messages, Announcements, Memos, Letters, and Reports

(12 Hrs)

**Recommended Books:**

**Textbooks:**
1. Adman Wallwork, *English for Writing Research Papers*, Springer New York Dordrecht Heidelberg London, 2011.
2. R Day, *How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006.
3. R Goldbort, *Writing for Science*, Yale University Press, 2006.
4. *MLA Handbook*, 2010.

## PCIE-813 INSTRUMENTATION SYSTEM DESIGN LAB

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 0 | 0 | 4 | 2 | 4 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** To obtain adequate knowledge in design of various signal conditioning circuits and instrumentation systems.

**CO 2:** To impart design knowledge of controller, control valve and transmitter.

**CO 3:** To acquire the knowledge of piping diagram of industrial standard.

**CO 4:** To make the students aware of industry project, planning and scheduling.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | M | | | | | | | | | | |
| CO2 | S | S | | M | | | | | | | | | | |
| CO3 | S | | | | | | | | | W | | | | |
| CO4 | M | | | | M | | | | | | | M | | |

**List of experiments**

1. Design of Instrumentation amplifier.
2. Design of active filters – LPF, HPF and BPF
3. Design of regulated power supply and design of V/I and I/V converters.
4. Design of linearizing circuits and cold-junction compensation circuit for thermocouples.
5. Design of signal conditioning circuit for strain gauge and RTD.
6. Design of orifice plate and rotameter.
7. Design of Control valve (sizing and flow-lift characteristics)
8. Design of PID controller (using operational amplifier and microprocessor)
9. Design of a multi-channel data acquisition system
10. Design of multi range DP transmitter

## PCIE-814  MODELLING AND SIMULATION LAB-I

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 0 | 0 | 4 | 2 | 4 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:**To provide background and fundamentals of MATLAB tool for the analysis and processing of signals.

**CO 2:** To generate various continuous and discrete time signals.

**CO 3:** To provide an overview of signal transmission through linear systems, convolution and correlation of signals and sampling.

**CO 4:** To understand the concept and importance of Fourier and Z-Transforms.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | M | | | | | | | | | | |
| CO2 | S | S | | M | | | | | | | | | | |
| CO3 | S | | | | | | | | | W | | | | |
| CO4 | M | | | | M | | | | | | | M | | |

**List of experiments**

1. Basic Operations on Matrices.
2. Write a program for Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit impulse, unit step, square, saw tooth, triangular, sinusoidal, ramp, sinc.
3. Write a program to perform operations like addition, multiplication, scaling, shifting, and folding on signals and sequences and computation of energy and average power.
4. Write a program for finding the even and odd parts of the signal / sequence and real and imaginary parts of the signal.
5. Write a program to perform convolution between signals and sequences.
6. Write a program to perform autocorrelation and cross correlation between signals and sequences.
7. Write a program for verification of linearity and time invariance properties of a given continuous/discrete system.
8. Write a program for computation of unit samples, unit step and sinusoidal response of the given LTI system and verifying its physical realizability and stability properties.
9. Write a program to find the Fourier transform of a given signal and plotting its magnitude and Phase spectrum.
10. Write a program for locating the zeros and poles and plotting the pole-zero maps in Z-plane for the given transfer function.

## PCIE-821 INDUSTRIAL PROCESS CONTROL

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 1 | 0 | 4 | 4 |

**Course Outcomes:**

**CO1:** Learn the classification and modeling of various industrial processes.

**CO2:** Explore the various process control and their applications in different industrial processes.

**CO3:** Understand the application advanced control concepts to different industrial processes.

**CO4:** Learn the application of DCS, Fuzzy and intelligent controllers in advance process control.

**CO5:** Have core competency of conventional and intelligent controllers used in industries

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | M | | | | | | | | | | |
| CO2 | S | S | | M | | | | | | | | | | |
| CO3 | S | | | | | | | | | W | | | | |
| CO4 | M | | | | M | | | | | | | M | | |

### Unit I

**Description and Modeling of Various Industrial Processes:** Model Classification, Mathematical Models, Physical Models, Analog Models, Estimation of Model Parameters, System Identification, Simulation, Steps Involved in Simulation Studies, Computer Simulation of Continuous and Discrete Systems with examples. Types and Description of Processes, Blending, Compressor & chiller controls, Distillation control, boiler controls

(12 Hrs)

**Process Control:** Types and Description of Processes, Blending, Compressor & chiller controls, Distillation control, boiler controls (12 Hrs)

### Unit II

**Process Controllers:** Process Control Loops with examples, Proportional-Integral-Derivative (PID) Controller, Cascade, Feed-forward, Feed-forward plus Feedback, Ratio control, Inferential control, Dead time and Inverse response compensation, Adaptive control, Model reference adaptive control, Self-tuning regulator Interactions and Decoupling of Control Loops: Design of cross controllers and selection of loops using Relative Gain Array

(12 Hrs)

**Intelligent Controllers:** Programmable Logic Controllers, Comparison with hard wired relay and semiconductor logic, Hardware, Ladder

diagram programming, Case studies, Evolution and advantages of computer control, Configuration of Supervisory, Direct digital control (DDC) and DCS.

(12 Hrs)

**Recommended Books:**

**Text Books:**

1. G. Stephanopoulos, *Chemical Process Control*, Prentice−Hall of India Private Limited
2. C.D. Johnson, *Process Control Instrumentation Technology*, Prentice−Hall of India Private Limited
3. Andrew and Williams, *Applied instrumentation in process industries, Vol. - 1/2/3*, Gulf professional.
4. R. Padmanabhan Tattamangalam, *Industrial Instrumentation: Principles and Design*, Springer Publication, 2000.

**Reference Books:**

5. Walt Boyes, Instrumentation Reference Book, 4th edition, Butterworth-Heinemann, 2009.
6. B. G. Liptak, Instrument Engineers Handbook, Vol- 1, CRC Press, 2003.

## PCIE-822  ADVANCED BIO-MEDICAL INSTRUMENTATION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Study neuronal, cardiovascular and respiratory system.

**CO 2:** Learn working principle of different type of electrodes for biomedical application.

**CO 3:** Impart knowledge of neuromuscular system, generation and sources of brain potential.

**CO 4:** Understand the need and importance of telemedicine in patient monitoring system.

**CO 5:** Study of Electro-Retinogram (ERG), Electro-Occulogram (EOG) and sources of noise in bioelectrical signal recording.

| CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| COs | Programme Outcomes (POs) | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S | | | | | | | | | | | M |
| CO2 | S | | | | | | | | | | | M |
| CO3 | S | M | | | | | | W | | | | M |
| CO4 | S | | | | | M | | | | S | | S |
| CO5 | S | M | | M | S | | | | | | | M |

## Unit I

**Human Body Subsystems:** Brief description of neuronal, muscular, cardiovascular and respiratory systems, their electrical, mechanical and chemical activities.

(04 Hrs)

**Biomedical Sensors:** Principles and classification of transducers for biomedical applications, electrode theory, different types of electrodes, selection criteria for transducer and electrodes.

(04 Hrs)

**Electrical Activity of Heart:** Cardiac system, bipolar and unipolar lead system, Einthoven triangle, electrodes, electrocardiogram-normal and abnormal, exercise ECG lead Positioning, electrode Positioning for Holter electrocardiogram (ECG) recording, vector cardiography, inverse cardiography, signal conditioning and processing.

(04 Hrs)

**Electrical Activity Of Neuromuscular System:** Muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, electrodes, correlation of force and work, Electromyography (EMG) integrators, signal conditioning and processing.

(06 Hrs)

**Electrical Activity of Brain:** Sources of brain potentials, generation of signals, component waves, EEG recording electrodes, 10-20 electrode system, Electroencephalogram (EEG) under normal, grand mal and Petit mal seizures, signals conditioning and processing.

(06 Hrs)

## Unit II

**Electrical Signals From Visual System:** Sources of electrical signals in eye, generation of

signals, Electro-retinogram, Electro-occulogram.

(06 Hrs)

**Noise And Interference in Bioelectrical Signals:** Sources on noise in bioelectrical signals recordings, filtering techniques-active and passive filters, digital filtering, grounding and shielding.

(06 Hrs)

**Introduction to Telemedicine:** Telemedicine System's classification, input and output peripherals, Characteristic of available transmission media, introduction to communication system for telemedicine. Medical image format standards, introduction to Digital Imaging and Communications in Medicine (DICOM) and Picture Archiving and Communication System(PACs) technologies various image compression techniques, loss less and lossy image compression for biomedical application. Telemedicine and law, confidentiality of telemedicine records, security in medical methods.

(12 Hrs)

**Recommended Books:**

**Text Books:**
1. R.S. Khandpur, *Handbook of Biomedical Instrumentation*, Tata McGraw-Hill.
2. Willis J. Tompkins and Webster, W.T, *Design of Microprocessor based medical instrumentation*, Englewood Cliffs.

**Reference Books:**
1. Joseph D. Bronzino, *The Biomedical Engineering Handbook*, 2ndSub edition, CRC Press, 1999.
2. Tatsuo Togawa and Toshiyo Tamura, *Biomedical Transducers and Instruments*, CRC Press, 1997.

# PEIE-821B TELEMETRY AND REMOTE CONTROL

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Introduce the importance and classification of telemetry system.

**CO 2:** Impart the knowledge of signal transmission techniques, transmitters and receiver.

**CO 3:** Understand the multiplexing, power line carrier and optical fiber communication.

**CO 4:** Learn layout, function and operation of Supervisory Control and Data Acquisition (SCADA) system.

**CO 5:** Describe the operation of SCADA system and communication between control center and remote terminal units.

| | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| Cos | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | | | |
| CO2 | S | | M | | M | | | | | S | | M | | |
| CO3 | M | | | | | | | | M | M | | | | |
| CO4 | S | | | | | | | | | M | | | | |
| CO5 | M | | | | | | | | | M | | | | |

## Unit I

**Introduction:** Introduction, classification and importance of telemetry, remote control, remote signaling, messages & signals, signal formation, conversion & transmission.

(12 Hrs)

**Signal Transmission Techniques:** Analog, pulse, digital modulation, amplitude modulation, AM transmitters and receivers, frequency modulation, FM transmitters & receivers, phase modulation, pulse modulation techniques, digital transmission techniques, error detecting & correcting codes.

(12 Hrs)

## Unit II

**Signal Transmission Media:** Wires & cables, power line carrier communication, terrestrial& satellite radio links, optical fiber communication, multiplexing- Time-division multiplexing (TDM), Frequency-division multiplexing (FDM) &Wavelength-division multiplexing (WDM).

(06 Hrs)

**Remote Control & Remote Signaling:** Principle of independent messages and combinational principle, multi-wire, FDM & TDM scheme.

(06 Hrs)

**Supervisory Control & Data Acquisition (SCADA):** Layout, functions & operation of SCADA system, remote terminal unit details, control center details, communication between control centers, communication between control center & remote terminal units, introduction to internet based telemetry.

(12 Hrs)

## RECOMMENDED BOOKS

**Text Books:**
1. D. Patranabis, *Telemetry Principle*, Tata McGraw-Hill, 1999.
2. Elliot l. Gruenberg, *Handbook of telemetry & Remote Control*, McGraw-Hill

**Reference Books:**
1. S.A. Ginzburg, I.A. Lekhtman and V.S. Malov*, Fundamentals of Automation & Remote Control*, 1st edition, Pergamon Press, 1996.
2. Tersen Legrell, *Power System Control Technology*, Prentice-hall.

## PEIE-821C MULTI-RATE SIGNAL PROCESSING

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

After successful completion of course, the students should be able to

**CO 1:** Introduce the importance and classification of Multirate signals.

**CO 2:** Impart the knowledge of Filters.

**CO 3:** Understand the reconstruction filter banks**.**

**CO 4:** Learn about various modulation techniques.

**CO 5:** Describe the operation of sampling theorem.

| Cos | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | | | |
| CO2 | S | | M | | M | | | | | S | | M | | |
| CO3 | M | | | | | | | | M | M | | | | |
| CO4 | S | | | | | | | | | M | | | | |
| CO5 | M | | | | | | | | | M | | | | |

### Unit-I

**Fundamentals of Multirate Theory**: The sampling theorem sampling at sub- Nyquist rate Basic Formulations and schemes,  Basic Multirate operations Decimation and Interpolation- Digital Filter Banks, DFT Filter Bank, Identities, Polyphase representation, maximally decimated filter banks: Polyphase representation  - Errors in the QMF bank- Perfect Reconstruction (PR) QMF Bank  -  Design of an alias free QMF Bank

(14 Hours)

**M-channel perfect reconstruction filter banks:** Uniform band and non-uniform filter bank  - tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems.

(14 Hours)

### Unit-II

**Perfect reconstruction (PR) filter banks:** Para-unitary  PR Filter Banks- Filter Bank Properties   induced by Para unitarity- Two channel FIR Para unitary QMF Bank-  Linear phase PR Filter banks- Necessary conditions for Linear phase property-  Quantization   Effects: -Types of quantization effects in filter banks.  - coefficient sensitivity effects,  dynamic range, and scaling

(13 Hours)

**Cosine Modulated filter banks:** Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase  distortion- Closed form expression- Polyphase structure-  PR Systems.

(13 Hours)

### RECOMMENDED BOOKS

**Textbooks:**

1. P.P. Vaidyanathan, *Multirate systems and filter banks*,  Prentice Hall. PTR.
2. N.J. Fliege, *Multirate digital signal processing*, John Wiley.

**Reference Books:**

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1. R.E. Crochiere. L. R, *Multirate Digital Signal* Processing,  Prentice Hall. Inc.
2. J.G. Proakis. D.G. Manolakis, *Digital Signal Processing: Principles. Algorithms and Applications*, 3rd Edn. Prentice Hall India.

## PEIE-821D  INDUSTRIAL ELECTRONICS

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand various power electronics devices such as SCR, TRIAC, IGBT etc.

**CO 2:** Study speed drive, closed loop drive and dual convertor.

**CO 3:** Learn working of frequency control of induction motor drives, braking and variable frequency drive.

**CO 4:** Describe self-controlled synchronous motor operation and its characteristics.

**CO 5:** Study working principle and application of AC and DC motor drives.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | W | | | | | | S | S | W |
| CO2 | S | M | W | | W | | | | | | | M | S | M |
| CO3 | S | M | W | | W | | | | | | | M | S | M |
| CO4 | S | M | W | | W | | | | | | | M | S | M |
| CO5 | S | | | | | W | | | | M | | S | M | W |

## Unit I

**Introduction:** Review of semiconductor power devices (Power diodes, Power Transistors, MOSFETS, IGBT, SCR, GTO, MCT, DIAC, TRAIC, PUT, SUS, SCS), Review of choppers, converters, inverters, cyclo-converters.

(12 Hrs)

**Closed Loop Control of DC Drives:** Single Quadrant variable speed drives; Four Quadrant variable speed drives, Armature voltage control at constant field, field weakening, details of various blocks of closed loop drives; drive employing armature reversal by a contactor, drive employing a dual converter with non- simultaneous and simultaneous control.

(12 Hrs)

## Unit II

**Frequency Controlled Induction Motor Drives:** Control of IM by VSI-3 phase VSI, six stepinverter voltage control, Pulse Width Modulated (PWM) inverter, breaking and multi-quadrant control, VSI variable frequency drives; control of induction machine (IM) by CSI- 3 phase CSI, current sources, Braking, PWM in a thyristor Current Source Inverter (CSI), PWM GTO CSI induction machine-IM, CSI variable frequency drives.

(12 Hrs)

**Self -Controlled Synchronous Motor Drives:** Self-control, brushless &commutator-less,DC& AC motors synchronous motor control-operation of a wound field and permanent magnet synchronous motor from a variable frequency current source; source, permanent magnet, operation of a permanent magnet motor at the maximum torque to armature current ratio and at the maximum torque to flux ratio; operation of self-controlled synchronous motor drives- CSI drives, VSI drives, cyclo-converters drives, brush-less and commutator-less AC & DC motor drives and their applications.

(12 Hrs)

**Recommended Books:**

**Text Books:**

1. G.K. Dubey, *Power Semiconductor Drives*, Prentice Hall (India), 1989.
2. Noel. M. Morris, *Industrial Electronics*, 2nd edition, McGraw-Hill, 1978

**Reference Books:**

3. Frank D. Petruzella, Industrial Electronics, Tata McGraw-Hill, 1995.
4. P.C. Sen, Power Electronics, 1st edition, Tata McGraw-Hill, 2001

## PEIE-821E  INDUSTRIAL INTERNET OF THINGS

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1**: Learn good understanding of Internet of Things (IoT) and its envisioned deployment domains.
**CO2:** Understanding of smart sensors/actuators with their internet connectivity for experimentation and designing systems.
**CO 3:** An overview about the various protocol standards deployed in the Internet of Things (IoT) domain and to make informed choices.
**CO 4:** Impart knowledge in the design and development of IoT systems with enablement ensuring security and assimilated privacy.

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | W | | | | | | S | S | W |
| CO2 | S | M | W | | W | | | | | M | | M | S | M |
| CO3 | S | M | W | | W | | | S | | | | M | S | M |
| CO4 | S | M | W | | W | | | | | | | M | S | M |
| CO5 | S | | | | | W | | | | M | | S | M | W |

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):

## Unit-I
**Introduction to Industrial Internet of Things -** Overview of Internet of Things- the Edge, Cloud and the Application Development, Anatomy of the Thing, Industrial Internet of Things (IIoT - Industry 4.0) and connected world, difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT

(06 Hrs)

**Communication Technologies of IIoT:** Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, 6LoWPAN, Bluetooth, BLE, NFC, RFID, Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

(06 Hrs)

**System Design of Connected Devices** - Embedded Devices, Embedded Hardware, Connected Sensors and Actuators, Controllers, Battery Life Conservation and designing with Energy Efficient Devices, SoCs, CC3200, Architecture, CC3200 Launchpad for Rapid Internet Connectivity with Cloud Service Providers. Front-end EDGE devices, Enterprise data for IIoT, Cloud data base, Cloud computing, Fog or Edge computing.

(12 Hrs)

## Unit II
**IIoT Protocols and Softwares:** MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP, XMPP and gateway protocols

(04Hrs)

**IIoT Privacy, Security & Governance -** Security Basics - Risk, Threat & Vulnerability, Risk Assessment, IIoT Security Framework based on IIC, Basic understanding of various IIoT security standards like NIST 82, IEC 62443, NERC, NIC etc., Hardware based Security, Overview of Data analytics, Cloud services, Use cases & Recent Trends in IIOT.

(12 Hrs)

**Case Study:** e-Health Body, City Automation, Plant Automation, Real life examples of IIOT in Manufacturing Sector, Smart irrigation, Automotive Applications

(08Hrs)

**Recommended Books:**

Text Books

1. Mahmood, Zaigham, *The Internet of Things in the Industrial Sector*, (Ed.), Springer Publication, 2020
2. Sudip Misra, Chandana Roy, and Anandarup Mukherjee, *Introduction to Industrial Internet of Things and Industry 4.0*, CRC Press, 2021
3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, *Industrial Internet of Things: Cybermanufacturing System*, Springer Publication.
4. Ismail Butun(editor), *Industrial IoT Challenges, Design Principles, Applications, and Security*.
5. Alasdair Gilchrist, "*Industry 4.0: The Industrial Internet of Things*", Apress 1st ed. Edition, 2017.
6. Joe Biron & Jonathan Follett, *Foundational Elements of an IoT Solution – The Edge, The Cloud and Application Development*, Oreilly,1st Edition, 2016.

## PEIE-821F DIGITAL SIGNAL PROCESSOR FOR INSTRUMENTATION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Learn about the basics of digital signal processing and its real-time significance.

**CO 2:** Acquire knowledge about the Digital Signal Processor (DSP) and its building blocks.

**CO 3:** Understand the Architecture of Programmable DSP and On-chip Peripherals.

**CO 4:** Implement the basic algorithms of DSP.

**CO 5:** Learn about the DSP applications in instrumentation.

| | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | M | M | | | | | | M | M | | S | | |
| CO2 | S | W | M | | M | | | | | | | M | | |
| CO3 | M | | S | | M | | | | | W | | W | | |
| CO4 | | M | S | | M | | M | | | | | W | | |
| CO5 | S | S | S | M | | S | M | M | S | M | M | S | | |

## Unit-I

**An Overview of Digital Signal Processing:** Signals and their origin, Noise and distortion, Basics of Digital Signal Processing (DSP), DSP in sample and frequency domain, Convolution, Fast Fourier Transform (FFT), Discrete Fourier Transform (DFT), Properties of the Discrete Fourier Transform (DFT), Linear and periodic convolution using the DFT, Discrete Wavelet Transform, Z-transform, Design and Analysis of Digital Filters, Adaptive Filters.

(08 Hrs)

**Introduction to Digital Signal Processor:** Basic architectural features, DSP processor computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation unit, Evolution of DSP Processors.

(08 Hrs)

**Programmable Digital Signal Processor:** Multiplier and Multiplier Accumulator (MAC), Modified Bus Structures, Memory Access Schemes, Multiple Access Memory, Multi-ported Memory, VLIW Architecture, Pipelining, Special Addressing Modes, On-chip Peripherals.

**DSP Development Tools:** DSP System Design Kit (DSK), Assemblers, Linker, C & C+ Compiler, Code Composer Studio, Programming examples to test DSK.

(08 Hrs)

## Unit-II

**TMS320C5X Digital Signal Processor:** Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register, Index Register, Block Move Address Register, Block Repeat Registers, Parallel Logic Unit (PLU), Memory-Mapped Registers, Program Controller, Flags in the Status Registers, On-Chip Memory and On-Chip Peripherals.

**TMS320C5X Assembly Language Instructions:** Assembly Language Syntax, Addressing Modes, Instruction Set: Load/ store, Arithmetic operation, Move, NORM and Program Control Instructions.

(08 Hrs)

**TMS320C3X Digital Signal Processor:** An overview of TMS320C3X Devices, Internal Architecture, Central Processing Unit, Memory Organization.

**Addressing Modes and Assembly Language of 'C3X':** Addressing modes, data formats, Assembly Language Instructions.

(08 Hrs)

**Applications of Digital Signal Processors in Instrumentation:** Design and Implementation of Digital Filters (FIR and IIR), Threshold detector, analysis of real-time data, Sensors Array Processing, Implementation of Proportional, Proportional-Integral and Proportional-Integral-Derivative Controller

(08 Hrs)

**Recommended Books:**
1. J. Proakis, D. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, Prentice-Hall, 2006.
2. B. Venkataramani, M. Bhaskar, *Digital Signal Processors – Architecture, Programming and Applications*. Tata McGraw – Hill, 2008.
3. A. Kumar, *Digital Signal Processing,* Second Edition. PHI Learning, 2014.
4. R. Chassaing, D. Reay, *Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK,* Wiley, 2011.

## PEIE-822A    OPTIMAL AND ROBUST CONTROL

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1:** Analyse optimal control problems, their classification along with performance indices and their selection

**CO2:** Discuss core competency of calculus of variation including Lagrange multiplier, Euler Lagrange equation, Transversality condition, equality & inequality constraints

**CO3:** Explain the dynamic programming along with causality, optimality, invariant in bedding and various optimization methods.

**CO4:** Learn various iterative methods of Optimization.

**CO5:** Be conversant in robust control system, its analysis and uncertain parameter, PID controller and designs examples.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|------|------|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | M | M | | | | | | M | M | | S | | |
| CO2 | | W | M | | M | | | | | | | | | |
| CO3 | M | | | | | | | | | W | | | | |
| CO4 | | M | S | | M | | M | | | | | W | | |
| CO5 | S | S | S | M | | | M | M | W | M | M | S | | |

## Unit I

**Introduction and Parametric Optimization:** Introduction to optimal control problems, Classification of optimal control problems, performance indices for optimal control and their selection, Dynamic optimization using.

(06 Hrs)

**Calculus of variations:** Lagrange multiplier, Euler Lagrange's equation for different conditions, Transversality conditions, Dynamic optimization with equality and inequality constraints.

(06 Hrs)

**Pontryegans Max/min Principle:** Optimization using Pontryegans maximum (minimum) principles with special emphasis on Bang-Bang type system.

(06 Hrs)

**Dynamic Programming in Continuous Time:** Developments of Hamilton Jacobi equation, Matrix Riccati equation, optimal control based on quadratic performance indices, Linear regulator and servomechanism problem.

(06 Hrs)

## Unit II

**Dynamic programming in Discrete System:** Dynamic programming multi stage decision processes in continuous time. Principle of causality, Invariant in bedding & optimality.

(06 Hrs)

**Iterative Method of Optimization:** Optimization using gradient methods and interactive techniques (steepest descent), Newton Raphson and Fletcher Powell. Introduction to multivariable system and decoupling, Introduction to Optimal Filters (Kalman Filter).

(06 Hrs)

**Robust Control System:** Introduction, Robust Control System and System sensitivity, Analysis of Robustness, system with uncertain parameters, the design of robust control system, PID controllers, and the design of robust PID controlled systems, design examples.

(12 Hrs)

**Recommended Books:**
**Text Books:**
1. M. Gopal, *Modern Control System Theory*, 2nd edition, John Wiley & Sons, 1993.
2. R.C. Drof and R.H. Bishop, *Modern control System*, 8th Edition, Pearson, 1998.

**Reference Books:**
1. Andrew P. Sage and Chelsea C. White-III, *Optimum Systems Control*, 2nd edition Prentice-Hall, 1997.
2. Brian D.O. Anderson and John B. Moore, *Optimum System Control*, Prentice-Hall, 2007.

## PEIE-822B    COMPUTATIONAL ELECTROMAGNETICS

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand design methods and the basics of electromagnetic, electrostatics.
**CO 2:** Utilize CAD and its features; study Finite Difference Method (FDM).
**CO 3:** Elaborate Finite Element Analysis-FEM and its features.
**CO 4:** Develop basics of special topics including hybrid methods.
**CO 5:** Analyze the application aspect of electromagnetics.

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | S | | | | | S | | | | | | | |
| CO2 | | | | S | | | | | | | | M | | |
| CO3 | M | | M | | | S | | M | | M | | | | |
| CO4 | | | | | | M | | | | | S | | | |
| CO5 | | | | | M | | M | | | | | | | |

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):

## Unit I

**Introduction:** Conventional design methodology, Computer aided design aspects–Advantages.

(04 Hrs)

**Electromagnetic and Electrostatics:** Basic field equations, calculation of field distribution, flux linkage, Voltage induced, inductance, capacitance, and force/torque. Electric and magnetic potentials, boundary conditions, Maxwell's equations, diffusion equation.

(08 Hrs)

**CAD packages:** Recent developments, processing, modeling, material characteristics, problem formulation, solution, Post processing, commercial packages.

(06 Hrs)

**Finite Difference Analysis-FDM:** Finite Difference Method (FDM): Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method. (06 Hrs)

## Unit II

**Finite Element Analysis-FEM:** Finite Element Method (FEM): overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

(12 Hrs)

**Special Topics:** hybrid methods, coupled circuit - field computations, electromagnetic -thermal and electromagnetic - structural coupled computations, solution of equations.

(06 Hrs)

**Applications:** Applications: low frequency electrical devices, static / time-harmonic /transient problems in transformers, rotating machines, actuators.

(06 Hrs)

**Recommended Books:**
**Text Books:**
1. Jian-Ming Jin, *The Finite Element method in Electromagnetics*, John Wiley & Sons, 2014.
2. M. V. K. Chari and Peter P. Silvester, *Finite Elements in Electric and Magnetic Field Problems*, Jon Wiley, 1980.

**Reference Books:**
3. D.A. Lowther and P.P Silvester, Computer Aided Design in Magnetics, Springer- Verlag New York, 1986.
4. Peter P. Silverster and Ronaldo L Ferrari, Finite Element for Electrical Engineers, Cambridge University Press, 1983.

## PEIE-822C    CONTROL SYSTEM  DESIGN

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1:** Thrash out the methods of representation of systems and their transfer function models.
**CO 2:** To provide adequate knowledge in time response of systems and steady state error analysis.
**CO 3:** To understand the concept of stability of control system and methods of stability analysis.
**CO 4:** To study the three ways of designing compensators for a control system.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | S | | | | | | | M | | | | | |
| CO2 | | M | S | | | W | M | | | | | W | | |
| CO3 | S | | S | M | | | | | | M | | | | |
| CO4 | | S | M | | | | | | | | | M | | |

## Unit I
**Introduction:** Control System Architecture, Design Specifications Functional in-equally specifications, multi-criteria optimization, norms of scalar & vector signals, norms of SISO LTI & MIMO LTI systems, state space methods for computing norms, design specifications assets, affine & convex sets and functions, closed loop convex design specifications, convexity & duality.
(12 Hrs)
**Design Specifications:** Reliability & closed loop stability, I/O specifications, regulation specifications, actuator effort, combined effect of disturbances & commands, differential sensitivity specifications, robustness specifications via gain bounds.

(12 Hrs)
## Unit II
**Compensators & Controllers Design:** Selection criteria and design of lead, lag, lead-lagand cascade type of compensators using Root locus & Bode plots, Rate feedback. Controllers – configuration and fundamentals of design, cascade and feedback compensation using various controllers.

(12 Hrs)
**State Variable Feed Back Design:** Introduction to state variable analysis, controllability and observability, state feedback for SISO system, state feedback design of SISO system using control canonical form. State variable feedback _ steady state error analysis, Use of steady state error coefficients, design of state observers, Introduction to design of MIMO systems. Introduction to design of non-linear system and software.

(12 Hrs)
**RECOMMENDED BOOKS:**
**Textbooks:**
1. M. Gopal, *Control Systems- Principle & Design*, 4th edition, Tata McGraw-Hill, 2012.
2. John Joachim D'Azzo, *Linear Control Analysis & Design*, 3rd edition, McGraw-Hill, 1988.

**Reference Books:**
1. John A Borrie, *Modern Control Systems- A manual of Design Methods*, Prentice Hall International.
2. Stepher P. and Craig H. Barratt, *Linear Controller Designs-Limits of Performance*, 5th edition, Prentice Hall International, 1991.

## PEIE-822D    INTELLIGENT CONTROL

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Gaining an understanding of the functional operation of a variety of intelligent control techniques and their bio-foundations.

**CO 2:** Learning analytical approaches to study properties (especially stability analysis), and use of the computer for simulation and evaluation.

**CO 3:** To understand about different soft computing techniques such as neural network, fuzzy logic, and evolutionary techniques for designing intelligent controllers.

**CO 4:** To design Intelligent controllers such fuzzy controller, neuro controller and evolutionary controllers.

| | | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | | | Programme Outcomes (POs) | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | S | | | | | M | | | | S | | | |
| CO2 | | M | S | | | M | | S | | | | W | | |
| CO3 | S | | S | | | | | | | M | | | | |
| CO4 | | S | M | | | | | M | | | | M | | |

## Unit I

**Artificial Neural Networks Applications to System Identification & Control:** Introduction, learning with ANNs, single-layer networks, multi-layer perceptron's, ANNs for identification, ANNs for control

(12 Hrs)

**Fuzzy Logic Control:** Introduction, fuzzy sets, fuzzy logic, fuzzy logic controller design, Fuzzy Modelling& identification, Adaptive Fuzzy Control Design, Parametric optimization of fuzzy logic controller using genetic algorithm.

(12 Hrs)

## Unit II

**Evolutionary Computation for Control & identification:** Applications of EC methods to system identification and control. Combination of Soft Computation Approaches.

(12 Hrs)

**Control & Identification:** System identification using Neuro-fuzzy, evolutionary neuro and evolutionary fuzzy systems. Lyapunov stability theory and Passivity Theory.

(12 Hrs)

**Recommended Books:**

**Textbooks:**
1. Rojer Jang, *Soft Computing*, PHI
2. D Driankov, H Hellendoorn and M Reinfrank, *n Introduction to Fuzzy Control*, Springer-Verlag, 2001.

**Reference Books:**
1. K. Passino, *Biomimicry for Optimization, Control, and Automation*, Springer-Verlag, London, UK, 2005
2. Stepher P. and Craig H. Barratt, *Linear Controller Designs-Limits of Performance*, 5th edition, Prentice Hall International, 1991.

## PEIE-822E   MACHINE LEARNING – AN APPROACH TO ARTIFICIAL INTELLIGENCE

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1**: Introduce the fundamental theory and concepts of machine learning and artificial intelligence

**CO 2:** Provide a comprehensive foundation to artificial neural networks, neuro-modeling, and their applications to pattern recognition.

**CO 3:** Explore the learning paradigms of supervised and unsupervised shallow/deep neural networks.

**CO 4:** Provide exposure to the recent advances in the field of and facilitate in depth discussions on chosen topic

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | M | S | | | S | | M | | | | S | | | |
| CO2 | | M | S | | | | | S | | | | W | | |
| CO3 | S | | | | M | | | | | | | | | |
| CO4 | | S | M | | | | | M | | | | M | | |

## Unit I

**Foundations of Machine Learning I:** Supervised and unsupervised learning, parametric vs non-parametric models, parametric models for classification and regression- Linear Regression, Logistic Regression, Naïve Bayes classifier, simple non-parametric classifier-K-nearest neighbour, support vector machines. Clustering- distance based- K-means, density based, association rule mining, validation techniques-cross validations, feature selection and dimensionality reduction, principal component analysis-Eigen values, Eigen vectors, Orthogonality- challenges motivating deep learning

(08 Hrs)

**Neural Networks for Classification and Regression:** ANN as a technique for regression and classification, structure of an artificial neuron, activation functions- linear activation, sigmoid and softmax. Feedforward neural networks- shallow model- single layer perceptron, multi-layer perceptron as complex decision classifier- learning XOR-Gradient based learning, Backpropagation algorithm, risk minimization, loss function, regularization, heuristics for faster training and avoiding local minima.

(8Hrs)

**Deep Feed Forward Neural Networks:** Feed forward neural networks- deep model- output units and hidden units, training deep models- hyper parameters and validation sets-cross validation, capacity, overfitting and under fitting, bias vs variance trade off, cross validation - vanishing gradient problem, new optimization methods (adagrad, adadelta, rmsprop, adam), regularization methods (dropout, batch normalization, dataset augmentation), early stopping.

(08 Hrs)

## Unit II

**Convolutional Neural Networks:** Convolution operation- kernel and feature map, sparse connectivity, equivariance through parameter sharing, pooling function for invariant representation, convolution and pooling as strong prior, convolution with stride, effect of zero padding, single-channel and multi-channel data types used in ConvNet, variants of basic

convolution- locally connected, tiled ConvNet- spatial separable and depthwise separable convolutions, fully connected layers, ConvNet architecture- layer patterns, layer sizing parameters,case studies- LeNet, AlexNet

(8Hrs)

**Recurrent Neural Networks:** Sequence learning with neural nets, unrolling the recurrence, training RNN- Backpropagation through time (BPTT), vanishing gradient problem, Gated recurrent unit (GRU), Long short term

(6Hrs)

**Deep Learning Tools and Applications** : Tools:TensorFlow, Keras, PyTorch, Caffe, Theano, MXNet. Applications: Object detection with RCNN – YOLO, SSD. Speech recognition with RNN.

(10Hrs)

**Recommended Books:**
**Text Book(s)**
1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, *Deep learning*, 2015, MIT Press
2. Josh Patterson and Adam Gibson, *Deep Learning- A Practitioner's Approach,* O'Reilly Media Inc., 2017, USA.
3. Oswald Campesato, *Artificial Intelligence, Machine Learning, and Deep Learning*, Mercury Learning & Information, 2020

**Reference Book(s)**
1. C.,M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2011.
2. E Rich and K Knight, *Artificial Intelligence*, 2011, 2nd ed., TMH, New Delhi.
3. Bengio, Yoshua, *Learning deep architectures for AI- Foundations and trends in Machine Learning*, 2(1)- 2009.
4. Tom M. Mitchell, *Machine Learning*, McGraw-Hill Education (India) Pvt Ltd, 2013.

# ACIE-821 AUDIT COURSE 2 (CONSTITUTION OF INDIA)

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successfully completing the course, students will be able to know about:

CO 1: Basic information about Indian constitution.

CO 2: Various organization of the governance.

CO 3: History & formation of Indian Constitution.

CO 4: Knowledge about Indian Judiciary.

CO 5: Knowledge About the constitutional body like election commission and its functioning.

| COs | CO/PO Mapping (S/M/W indicates strength of correlation ) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes ( POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO :1 | | | | S | | | | | | | | | | |
| CO :2 | | | | | S | | | | | | | | | |
| CO :3 | | | | | | | | S | | | | | | |
| CO :4 | | | | | | S | | | | | | | | |
| CO :5 | | | | | | | S | | | | | | | |

## Unit- I

**History of Making of the Indian Constitution:** History, Drafting Committee,(Composition & Working).

**Philosophy of the Indian Constitution**: Preamble, Salient Features.

**Contours of Constitutional Rights & Duties:** Fundamental Rights, Right to Equality,Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural andEducational Rights, Right to Constitutional Remedies, Directive Principles of State Policy,Fundamental Duties

(16Hrs)

## Unit-II

**Organs of Governance:** Parliament, Composition, Qualifications and Disqualifications,Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary,Appointment and Transfer of Judges, Qualifications, Powers and Functions.

(14Hrs)

## Unit- III

**Local Administration:** District's Administration head: Role and Importance,Municipalities: Introduction, Mayor and role of Elected Representative, CEO of MunicipalCorporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles,CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Differentdepartments), Village level: Role of Elected and Appointed officials, Importance of grass rootdemocracy

(12Hrs)

## Unit- IV

**Election Commission:** Election Commission: Role and Functioning. Chief ElectionCommissioner and Election Commissioners. State Election Commission: Role and Functioning.Institute and Bodies for the welfare of SC/ST/OBC and women.

(14Hrs)

**Recommended Books:**

**Text Book(s)**

1. *The Constitution of India*, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, *Framing of Indian Constitution*, 1st Edition, 2015.
3. M. P. Jain, *Indian Constitution Law*, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, *Introduction to the Constitution of India*, Lexis Nexis, 2015.

## PCIE-823  ADVANCED BIO-MEDICAL INSTRUMENTATION LAB

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 0 | 0 | 4 | 2 | 4 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1**: Acquire the knowledge observe neuronal, cardiovascular and respiratory system.

**CO 2:** Learn working principle of different type of electrodes for biomedical application.

**CO 3:** Impart knowledge of neuromuscular system, generation and sources of brain potential.

**CO 4:** Understand the need and importance of telemedicine in patient monitoring system.

**CO 5:** Analyze electro-retinogram (ERG), electro-occulogram (EOG) and sources of noise in bioelectrical signal recording.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): |||||||||||||
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) ||||||||||||||
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | M | | |
| CO2 | S | | | | | | | | | | | M | | |
| CO3 | S | M | | | | | | W | | | | M | | |
| CO4 | S | | | | | M | | | | S | | S | | |
| CO5 | S | M | | M | S | | | | | | | M | | |

To understand the practicability of Biomedical Instrumentation and Telemedicine, a list of experiments is given below to be performed in the laboratory.

1. To design various types of active filters to remove noise in biomedical signals.
2. To study statistical analysis of biomedical signals.
3. To measure pulse rate using a pulse rate monitor.
4. To study thermal conductivity type sensors used in biomedical systems.
5. To study the health of lungs with the help of spirometer.
6. To analyze the rest ECG and moment ECG on a TMT machine.
7. To study the spectral characteristics of EEG signal.
8. To Compare the EMG signal obtained from unipolar electrodes.
9. To study QRS detection circuit and find out heart rate using R-R interval.
10. To find the effect of noise on ECG signal.

**Recommended Books:**

**Text Books:**

1. R.S. Khandpur, *Handbook of Biomedical Instrumentation*, Tata McGraw-Hill
2. Willis J. Tompkins and Webster, W.T, *Design of Microprocessor based medical instrumentation*, Englewood Cliffs.

**Reference Books:**

3. Joseph D. Bronzino, *The Biomedical Engineering Handbook*, 2ndSub edition, CRC Press, 1999.
4. Tatsuo Togawa and Toshiyo Tamura, *Biomedical Transducers and Instruments*, CRC Press, 1997.

## PCIE-824 MODELLING AND SIMULATION LAB-II

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 0 | 0 | 4 | 2 | 4 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1**: Acquire the knowledge of simulation concepts.
**CO 2:** Learn the transient behavior of basic signals used in electrical and instrumentation engineering.
**CO 3:** Impart knowledge of simulation of engineering problems related to electrical, control, and instrumentation engineering.
**CO 4:** Understand the need for and importance of simulation and modelling.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | M | | |
| CO2 | S | | | | | | | | | | | M | | |
| CO3 | S | M | | | | | | W | | | | M | | |
| CO4 | S | | | | | M | | | | S | | S | | |

**List of experiments is given below to be performed in the laboratory.**

1. Simulation of Transient response of RLC Circuit To an input (i) step (ii) pulse and(iii) Sinusoidal signals.
2. Analysis of Three Phase Circuit representing the generator transmission line and load. plot three phase currents and neutral currents.
3. Simulation of Single-Phase full converter using RLE loads and single-phase AC Voltage Controller using RL loads.
4. Plotting of Bode plots, Root Locus and Nyquist plots for the transfer functions of systems up to 5th order.
5. Power System load flow using Newton-Raphson Technique.
6. Modeling of Transformer and simulation of lossy transmission line.
7. Integrator and Differentiator circuits using OP-AMP.
8. Simulation of DC separately excited motor using Transfer function approach.
9. Simulation of Buck & Boost converters.
10. Simulation of single-Phase Inverter with PWM control.

**Recommended Books:**
**Text Books:**
1. B.P. Zeigler, H. Praehofer and I.G Kim, *Theory of modeling and simulation*, 2 nd Edition. Academic press 2000
2. K Ogata, *Modern control Engineering*, 3 rd edition, Prentice Hall of India 2001.
**Reference Books**
1. J.S.R. Jang, C.T sun and E Mizutani, *Neuro-Fuzzy and soft Computing*, 3rd edition, Prentice hall of India 2002
2. R. E. Shannon, *System Simulation: the Art and Science*, Prentice Hall Inc. 1990.
3. R Pratab, *Getting started with MATLAB*, Oxford university Press 2009.

## PCIE-825   SEMINAR

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 0 | 0 | 2 | 1 | 2 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Communicate their work effectively through writing and presentation.

**CO 2:** Use research based knowledge in the latest area of technology.

**CO 3:** Engage in independent and life-long learning

**CO 4:** Implement the project requiring individual skills.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | | | | S | | | | |
| CO2 | S | | | S | | | | | | | | S | | |
| CO3 | | | | | | | | | | | | S | | |
| CO4 | | | | | | | | | S | | | | | |

Objectives of the programme is to

1. Familiarize the students with the outside professional environment.
2. Make the students able to use the resources for the given problem/assignment.
3. Update the students with modern trends of electrical engineering.
4. Develop own opinions, particularly on issues, based on critical and reasonable approach to the information available.
5. Make the students able to present work in written, oral or formal presentation formats.

## PEIE-911A    MICROPROCESSOR APPLICATIONS IN INSTRUMENTATION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1:** Understand evolution, 8086 microprocessor architecture & types of microprocessors.
**CO 2:** Develop assembly language programs of 8086 microprocessor.
**CO 3:** Explain the details of subroutines and addressing techniques of 8086 microprocessor.
**CO 4:** Exercise interfacing of 8086 microprocessor with various peripheral devices.
**CO 5:** Develop and analyse application of 8086 microprocessor in various areas.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | S | | | | | | | |
| CO2 | | | M | | | | | | | S | | M | | |
| CO3 | | | | | | S | | M | | | | | | |
| CO4 | | | | | | M | | | | | | | | |
| CO5 | | S | | | M | | M | | | | M | | | |

## Unit I
**Architecture of Microprocessor:** Introduction to evolution of microprocessors, 8086 architecture; block diagram and pin configuration, comparison of 80186, 80286, 80386, 80486 and Pentium; architecture based.

(12 Hrs)

**Programming of 8086 Microprocessor:** Assembly language programming of 8086microprocessor, addressing techniques, subroutines, macros, co-routines, functions.

(12 Hrs)

## Unit II
**Interfacing of 8086 Microprocessor:** Interfacing with general purpose peripheral devices; 8255, 8253, 8259, 8279 and memory Disk controller, Cathode Ray Tube (CRT) controller and printer controller.

(12 Hrs)

**Applications of 8086 Microprocessor:** Applications: stepper motor control, traffic control, DAS.
(12 Hrs)

**Recommended Books:**
**Text Books:**
1. A K Ray & K M Bharchand, *Advanced microprocessor and peripherals, architecture, programming and interfacing*, TMH, 2007.
2. Douglas V Hall, *Microprocessors and Interfacing, Programming and Hardware*, TMH, 1992.

**Reference Books:**
1. Barry B. Brey, *The Intel Microprocessor 8086, 80186, 80286, 80386, 80486, Pentium: architecture, programming & interfacing*, PHI, 2008.
2. Barry Kauler, *Windows Assembly Language & Systems Programming: 16-and 32-Bit Low-Level Programming for the PC and Windows*, Taylor and Francis, 1997.

## PEIE-911B    ROBOTICS ENGINEERING

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand basics of robotics and kinematics of robotics is described.

**CO 2:** Develop basics of sensors used for various purposes.

**CO 3:** Understand the control of robots, different end effectors like mechanical, magnetic etc.

**CO 4:** Design programs for robot using various programming languages.

**CO 5:** Analyze the application of robotics in various fields and future of robotics.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | S | | | | | | M | S |
| CO2 | M | | | | | | | | | | | M | M | S |
| CO3 | | M | | | | S | | M | | | | | M | S |
| CO4 | | | | | | M | | | | | | | M | S |
| CO5 | | | | | M | | M | | | | | | M | S |

## Unit I

**Introduction:** Basic concepts, Robot anatomy, Robot configurations, Basic Robot motions, Types of drives, manipulator end effectors, controller, power unit.

(06 Hrs)

**Transformations and Kinematics:** Vector operations, Translational transformations and Rotational transformations, Properties of transformation matrices, Homogeneous transformations and Manipulator, Forward solution, Inverse solution.

(06 Hrs)

**Sensory Devices:** Non optical and optical Position sensors, Range, Proximity, touch, slip, Machine vision, Image components, Representation, Hardware, picture coding, object recognition and categorization, software consideration.

(12 Hrs)

## Unit II

**Controls and End Effectors:** Control system concepts, Analysis, control of joints, adaptive and optimal control, End effectors, classification, Mechanical, Magnetic, Vacuum, Adhesive, Drive systems, Force analysis and gripper design.

(12 Hrs)

**Robot Programming:** Methods, Languages, types of programming, Robotic programming languages.

(06 Hrs)

**Robot Applications:** Applications of robotics in material handling, machine loading and unloading, processing applications, welding and painting assembly and inspection, future robotic applications and related technologies developments.

(06 Hrs)

**Recommended Books:**

**Text Books:**

1. Richard David Klafter, Thomas A. Chmielewski and Michael Negin, *Robot Engineering an Integrated Approach*, Prentice Hall, 2009.
2. Yorem Koren, *Robotics for Engineering*, McGraw-Hill, 1985.

**Reference Books:**

1. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, *Industrial Robotics, Technology programming and Applications*, McGraw Hill, 2012.
2. John J.Craig, *Introduction to Robotics Mechanics and Control*, Addison-Wesley, 1999.

## PEIE-911C   OPTO-ELECTRONICS AND INSTRUMENTATION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1:** Understand fundamental properties of light and basics of optical components.
**CO 2:** Understand the different applications of laser and fiber optics.
**CO3:** Analysis the characteristics, design architectures and trade-offs of semiconductor lasers.
**CO 4:** Design architectures and trade-offs of optical detectors and modulators of light.
**CO 5:** Understand basic fundamental theory of fiber optics and holography.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | | | S | | | | | | M | S |
| CO2 | S | | | M | | | | | | | | M | M | S |
| CO3 | | M | | | | S | | M | | | | | M | S |
| CO4 | | | | | | M | | | | | S | | M | S |
| CO5 | | | | | M | | S | | | | | | M | S |

## Unit I

**Introduction:** Ray theory of transmission, total internal reflection, electromagnetic mode theory of optical propagation, Fiber types, Step & Graded index fiber structure, propagation of light through fiber.

(06 Hrs)

**Transmission characteristics of optical fiber:** signal attenuation and signal distortion in optical wave-guides, optimal design of single mode fibers, fiber bend loss, dispersion, intermodal dispersion, dispersion modified single mode fiber, polarization, nonlinear phenomena.

(06 Hrs)

**Optical Sources:** Characteristics of Lasers, Einstein's equations, population inversion two, three and four level system. Laser rate equation, laser diode structures radiation pattern, modes, and single mode lasers, modulation of laser diodes & temperature effects, noises in laser diodes. Light-emitting diode (LEDs) - structures, materials, internal quantum efficiency, modulation capability, transient response & power bandwidth product.

(08 Hrs)

## Unit II

**Photo Detectors:** optical detector principles, absorption, quantum efficiency, responsively, photo diodes, modulation. pin photo detectors, avalanche photo diodes, CCDs, photomultiplier tube, photo detector noise, detector response time, avalanche multiplication theory and noise,. Solar cell materials and their properties, solar cell parameters, optical losses; electrical losses, surface recombination velocity.

(08 Hrs)

**Applications of Fiber optic and Lasers:** Fiber optic sensors for common industrial parameters - V, I, pressure, and temperature. Fiber optic gyroscope. Laser based measurement of distance and length, velocity, acceleration, atmospheric effects, pollutants. Laser heating, melting, scribing, splicing, welding and trimming of materials, removal and vaporization.

(08 Hrs)

**Holography:** Principle of holography, theory, requirements and applications.

(04 Hrs)

**Recommended Books:**

**Text Books:**
1. John M. Senior, *Optical fiber Communications Principles and Practice*‖, PHI publication, 2nd ed., 2008.
2. Ajoy Kumar Ghatak and K. Thyagarajan, *Optical Electronics*, Cambridge University Press, 1989.
3. Wilson and Hawkes, *Opto-Electronics: An Introduction*, Third Edition, Pearson Education, 1998.
4. John Ready, *Industrial Applications of Lasers*, Second Edition, Academic Press, 1997.

**Reference Books:**
1. John Gowar, *Optical Electronics*, Prentice Hall, 1993.
2. Gerd E. Keiser, *Optical Fibre Communication*, McGraw-Hill, 2008.

## PEIE-911D  SYSTEM IDENTIFICATION AND PARAMETER ESTIMATION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO1**: Discuss concepts and methodologies for parameter identification tools.
**CO2**: implement approaches for parameter estimation.
**CO3**: to identify multivariable systems (MVS) and closed loop systems.
**CO4**: discuss the model structure, models, order selection, validation and experiment design.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | | | | | S | | | | | | | | M | S |
| CO2 | S | | | M | | | | | | | | M | M | S |
| CO3 | | M | | | | S | | M | | M | | | M | S |
| CO4 | | | | | | M | | | | | S | | M | S |
| CO5 | | S | | | M | | S | | W | | | | M | S |

## Unit I
**Principles of Modelling and Transfer function identification:** System Identification and Stochastic Modeling- Structure and parameter estimation, Properties of estimates - validation of models-impulse Response. Step Response. Frequency response- transfer function from these.- disturbances and transfer function, State Space Models- Distributed parameter models- model structures, Identifiably of model structures. Signal spectra, Signal realization and ergodicity. Multivariable systems, Transfer functions from frequency response, Fourier Analysis and Spectral analysis- Estimating Disturbance Spectrum, Correlation Identification, Practical Implementation, Pseudo random binary signals, Maximum length sequences, Generation using hardware, random number generation on digital computer.

(12 Hrs)

**Parameter Estimation Methods:** Guiding principles behind parameter estimation methods, Minimizing prediction errors, Linear regression and least squares methods, Statistical framework for parameter estimation, Maximum likelihood estimation, Correlating prediction errors with past data, Instrumental variable method, Consistency and identifiably- Recursive methods, RLS Algorithm, Recursive IV Method- Recursive Prediction Error Method, Recursive pseudo-linear regressions, choice of updating step.

(12 Hrs)

## Unit II
**Identification of Multivariable Systems (MVS) and Closed Loop Systems:** Transfer function matrix representation of MVS- state space method input output difference equation method - canonical models for MVS, Comparison of different models, Identification of continuous MV systems from input output data, Identification of closed loop systems, Reduction of higher order systems, Aggregation method, Aggregation with partial realization, Singular perturbation method, Optimum approximation, comparison of different methods of model reduction.

(12 Hrs)

**Experiment Design and Choice of Identification Criterion:** Optimal Input design, Persistently exciting condition, Optimal input design for higher order black box models, Choice of sampling interval and pre-sampling filters, Choices of Identification criterion, Choice of norm, variance: optimal instruments.

(12 Hrs)

**RECOMMENDED BOOKS:**
**Text Books:**
1. Thomas Kailath, *Linear Estimation*, Prentice Hall, 2000.
2. Harold W Sorensen, *Parameter Estimation: Principles and Problems (Control and Systems Theory)*, vol. 9, Marcel Dekker Inc., 1980.

**Reference Books:**
1. Daniel Graupe, *Identification of Systems*, Van Nostrand.
2. Lennart Ljung, *System Identification Theory for the User*, Prentice Hall Information, Systems Science Series.

## PEIE-911E ARTIFICIAL INTELLIGENCE IN MEDICAL DIAGNOSIS

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1:** Learn about the basics of Artificial Intelligence.
**CO 2:** Understand the various algorithms.
**CO 3:** Learn about the different types of AI and their significance for different problems.
**CO 4:** Implement the AI algorithms for disease diagnosis and health care.
**CO 5:** Know about the various ethical, legal, and social issues of AI in medicine.

| CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| **COs** | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | M | | | | | | M | M | | S | | |
| CO2 | S | W | M | | M | | | | | | | M | | |
| CO3 | M | | | | M | | | | | W | | W | | |
| CO4 | | M | S | | M | | M | | | | | W | | |
| CO5 | S | S | S | M | | S | M | M | S | M | M | S | | |

## Unit-1
**Introduction to Human and Artificial Intelligence**: Terminologies, Computational models of intelligence; Conceptual frameworks cognitive, neuroscience, and information theory; philosophical foundations of AI Review of relevant mathematical and statistical concepts.

(4 Hrs)

**Algorithms:** Classification Algorithms: Naive Bayes, Decision Tree, Random Forest, Support Vector Machines, K Nearest Neighbours. Regression Algorithms: Linear regression, Logistic Regression, Multivariate Regression, Multiple Regression Algorithm. Clustering Algorithms: K-Means Clustering, Fuzzy C-means Algorithm, Expectation- Maximisation (EM) Algorithm and Hierarchical Clustering Algorithm.

(10 Hrs)

**Forms of Artificial Intelligence Learning**: Supervised Learning: (a) Decision trees, non-parametric methods for learning, support vector machines, (b) Bio-inspired Learning (from perceptron to deep learning): neural basis of computing, classical neural networks, deep neural networks, deep belief networks, recurrent neural networks, and Convolutional Neural Networks. Unsupervised Learning: basic and advanced clustering techniques, dimensionality reduction (feature selection and feature extraction).Knowledge Representation and Reasoning: Prepositional logic, first-order logic, ontological engineering, probabilistic reasoning

(10 Hrs)

## Unit-2
**Applications of Artificial Intelligence in disease diagnosis:** Cardiology and Heart Disease Diagnosis, Analysis of Electromyography Signals, Electroencephalogram Analysis, Gait and Movement Pattern Analysis, Cancer Prediction Using an Enhanced Artificial Neural Network–Based Classifier

(10 Hrs)

**Applications of Artificial Intelligence in Health Care:** Approach for Medical Decision Support, Patient Care and Treatment, Deep Learning Oriented Robotics for Biomedical, Comparison of AI with Traditional Solutions for Biomedical.

(10 Hrs)

**Implementation and Evaluation:** Model evaluation and performance metrics, cross-validation, model interpretability, Ethics of AI: bias, fairness, accountability, and transparency in machine learning; Ethical, Legal, and Social Issues of AI in medicine and healthcare.

(4 Hrs)

**Recommended Books:**

5. A. Agah, *Medical Applications of Artificial Intelligence,* CRC Press, 2013.
6. U. Kose, O. Deperlioglu, D. J. Hemanth, *Deep Learning for Biomedical Applications,* CRC Press, 2021.
7. R. Begg, T. H. Lai, M. Palaniswami, *Computational Intelligence in Biomedical Engineering,* CRC Press, 2008.

## OEIE-911A    MICROCONTROLLERS AND EMBEDDED SYSTEMS

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1:** Learn basics of Microprocessor, Micro-controllers and study 8051 micro-controller architecture.

**CO2:** Understand the basic programming and create basic assembly language programs.

**CO3:** Demonstrate the design of 8051 Microcontroller, memory details, subroutines and serial data.

**CO4:** Identify, analysis and implement the application of microcontroller and the simulators used for this purpose.

**CO5:** Examine practical design implementation using programmable logic device (PLD) and FPGA- architecture.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | W | | | | | | | | |
| CO2 | | M | S | | M | | | | | | | | | |
| CO3 | | M | | | | | | | M | M | | | | |
| CO4 | | S | M | | S | | | | W | M | | | | |
| CO5 | | | M | M | | | | | | | | M | | |

## Unit I

**Introduction:** Microprocessor, Micro-controllers and their comparison.

(06 Hrs)

**The 8051 Architecture:** Introduction, 8051 micro-controller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts.

(06 Hrs)

**8051 Assembly Language Programming:** The mechanics of programming, assembly language programming process, programming tools and techniques, instruction set (data moving, logical operations, arithmetic operations jump and call instructions).

(12 Hrs)

## Unit II

**8051 Microcontroller Design:** Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding I/O, memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission.

(12 Hrs)

**Microcontroller Applications:** Interfacing keyboards, displays, Digital to Analog (D/A) and Analog to Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators.

(06 Hrs)

**Embedded Systems:** Introduction to programmable logic device (PLDs) and field-programmable gate array (FPGA) - architecture, technology and design issues, implementation of 8051 core.

(06 Hrs)

**Recommended Books:**
**Text Books:**

3. John B. Peatman, *Design with Microcontroller*, Prentice Hall, 1997.
4. Kenneth J. Ayola, *The 8051 Micro Controller- Architecture, Programming and Application*, 2nd edition, Thomson Delmar Learning, 1996.

**Reference Books:**
4. A.K. Ray and K.M. Bhurchandi, *Advanced Microprocessors & Peripherals: Architecture, Programming & Interfacing*, TMH, 2006.
5. Muhammad Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Micro-controller & Embedded system*, Pearson Education, 2007.
6. V. Udayashankara and M.S. Mallikarjunaswamy, *8051-Microcontroller: Hardware, Software and Applications*, 1st edition, Tata McGraw Hill, Pvt. Ltd. New Delhi, 2009.

## OEIE-911B   ENERGY AUDITING AND MANAGEMENT

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**
After successful completion of course, the students should be able to
**CO 1:** Understand the basic aspects of energy audit and management.
**CO 2:** Analyze the basic energy management approach.
**CO 3:** Comprehend the knowledge of energy audit and its application to the field of the various engineering related problems.
**CO 4:** Apply various data gathering and analytical techniques of energy audit.
**CO 5:** Study the Energy Policy Planning and Implementation.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | W | M | | | | S | W |
| CO2 | S | M | | | W | W | | | | M | | | S | W |
| CO3 | M | | M | S | | M | W | | | M | W | M | S | M |
| CO4 | M | M | S | W | M | | | M | S | W | M | | W | S |
| CO5 | S | | W | | | S | M | M | M | M | M | S | M | S |

## Unit I

**Introduction:** General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy.

(04 Hrs)

**Energy Audit:** Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, maximizing system efficiency. Optimizing the input energy requirements, Fuel and Energy substitution.

(04 Hrs)

**Data gathering :** Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

(04 Hrs)

**Analytical Techniques:** Incremental cost concept, mass and energy balancing techniques, inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process, and energy system simulation.

(06 Hrs)

**Evaluation of saving opportunities:** Determining the savings in INR, Noneconomic factors, Conservation opportunities, estimating cost of implementation.

(03 Hrs)

**Energy Audit Reporting:** The plant energy study report- Importance, contents, effective organization, report writing and presentation

(03 Hrs)

## Unit II

**Energy Policy Planning and Implementation:** Force Field Analysis, Energy Policy-Purpose, Perspective, Contents and Formulation. Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivation of employees, Requirements for Energy Action Planning, Designing, Barriers, Strategies,

Marketing and Communicating Training and Planning.

(10 Hrs)

**Energy Balance & MIS:** First law of efficiency and Second law of efficiency, Facility as an Energy system, Methods for preparing process flow, Materials and Energy Balance diagram, Identification of losses, Improvements, Energy Balance sheet and Management Information System (MIS), Energy Modeling and Optimization.

(10 Hrs)

**Energy Audit Instruments:** Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy.

(04 Hrs)

**RECOMMENDED BOOKS:**
**Text Books:**
   1.W.R.Murphy, G.Mckay, *Energy Management*, Butterworths.
   2. C.B.Smith, *Energy Management Principles*, Pergamon Press.
**Reference Books:**
   1. *CRC Handbook of Energy Efficiency*, CRC Press.
   2. *Industrial Energy Conservation Manuals*, MIT Press, Mass, 1982.
   3. W.C. Turner, *Energy Management Handbook*, John Wiley and Sons, A Wiley Interscience Publication.

## OEIE-911C   VIRTUAL INSTRUMENTATION AND DATA ACQUISITION

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand the knowledge of virtual instrumentation and measurement systems.

**CO2:** Application of ~~Lab View~~ LabVIEW software for data acquisition purpose and System control application.

**CO 2:** Hand-on exercises with Plug-in DAQ board & devices.

**CO 3:** Focuses on the development of prototype Virtual Instrumentation.

**CO 4:** To learn the programming, data acquisition hardware and implementing small projects.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | W | M | S |
| CO2 | | | | | S | | | | S | | | | M | S |
| CO3 | | | S | | | | | | S | | | | M | S |
| CO4 | | | ~~S~~ | | S | M | | | S | | M | S | M | S |
| CO5 | | | | | | | | | | | | | M | S |

## Unit I

**Introduction:** Virtual Instrumentation—Definition, flexibility—Block diagram and Architecture of Virtual Instruments — Virtual Instruments versus Traditional Instruments — Review of LabVIEW software in virtual Instrumentation and programming techniques.

(12 Hrs)

**Data Acquisition in Virtual Instrumentation:** A/D, D/A converters, plug-in Analog input/output cards - Digital Input/output cards, Organization of the DAQ VI system - Opto isolation - Performing analog input and analog output - Scanning multiple analog channels - Issues involved in selection of data acquisition cards - Data acquisition modules with serial communication.

(12 Hrs)

## Unit II

**Communication Networked Modules:** Introduction to PC Busses—Local busses: ISA—PCI — RS232 — RS422 — RS485 — Interface Busses — USB, PCMCIA, VXI, SCXI, PXI - Instrumentation Buses: Modbus — GPIB - Networked busses — ISO/OSI Reference model, Ethernet — TCP/IP protocols.

(12 Hrs)

**Real Time Control in Virtual Instrumentation and Applications:** Design of ON/OFF controller, simulation of industrial instruments and systems, VI functions and objects including signal processing and analysis. Typical instruments and systems -digital storage oscilloscope, spectrum analyzer, waveform generator, Data visualization from multiple locations; Distributed monitoring and control devices.

(12 Hrs)

**Recommended Books:**
**Text Books:**

1.  L.K. Well and J. Travis, *LabView for everyone*, Prentice Hall, 1995.
2.  S. Gupta and J.P. Gupta, *PC interfacing for data acquisition and process control*, 2<sup>nd</sup> edition,ISA,1994.

**Reference Books:**

1.  Gary W. Johnson, *LabView Graphical Programming*, McGraw Hill, 1997.
2.  Rahman Jamal and Herbert Pichlik, *LabView–applications and solutions*, National Instruments Release, 1998.

## OEIE-911D-INDUSTRIAL SAFETY

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand the basic aspects of industrial safety.

**CO 2:** Analyze the basic principles of machine guarding.

**CO 3:** Comprehend the knowledge of safety in welding and gas cutting.

**CO 4:** Apply various analytical techniques of safety measurements.

**CO 5:** Study the safety standards of boilers in India.

| | | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | | Programme Outcomes (POs) | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | | | |
| CO2 | S | M | | | | W | | | M | | | S | | |
| CO3 | M | | | S | | | | | | M | | M | | |
| CO4 | M | | | | | | | M | | | | | | |
| CO5 | S | | | S | | | | | | | M | | | |

## Unit I

**SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES:** General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine, and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards, and codes- saws, types, hazards.

(08 Hrs)

**PRINCIPLES OF MACHINE GUARDING:** Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. , benefits of good guarding systems.

(08 Hrs)

**SAFETY IN WELDING AND GAS CUTTING**: Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-color coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

(08 Hrs)

## Unit II

**SAFETY IN COLD FORMING AND HOT WORKING OF METALS:** Cold working, power presses, point of operation safeguarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection, and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safeguards in hot rolling mills – hot bending of pipes, hazards, and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work

environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

(12 Hrs)

**SAFETY IN FINISHING, INSPECTION AND TESTING:** Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

(12 Hrs)

**Recommended Books:**
**Textbooks:**
1. *Accident Prevention Manual*, NSC, Chicago, 1982.
2. *Occupational safety Manual*, BHEL, Trichy, 1988.
3. John V. Grimaldi and Rollin H. Simonds, *Safety Management*, All India Travelers Book seller, New Delhi, 1989.
4. N.V. Krishnan, *Safety in Industry,* Jaico Publishery House, 1996.

**Reference Books:**
1. *Indian Boiler acts and Regulations*, Government of India.
2. *Safety in the use of wood working machines*, HMSO, UK 1992.
**3.** *Health and Safety in welding and Allied processes*, Welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

## OEIE-911E-SOFT COMPUTING TECHNIQUES

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand Fuzzy logic and its applications.

**CO 2:** Understand Artificial neural networks and its applications.

**CO 3:** Solve single-objective optimization problems using GAs.

**CO 4:** Solve multi-objective optimization problems using Evolutionary algorithms.

**CO 5:** Know the applications of soft computing to solve problems in varieties of application domains.

**PSO1:** Apply knowledge to design, analyze and synthesize problems related to Instrumentation and Control Engineering.

**PSO2:** To evolve innovative solutions for real-time and industrial problems using skills, modern tools and recent technologies.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|     | Programme Outcomes (POs) |
|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S |   |   |   |   |   |   |   |   |   | S |   |   |   |
| CO2 |   | M |   |   |   | W |   |   | M |   |   | S |   |   |
| CO3 | M |   |   | S |   |   |   |   |   | M |   | M |   |   |
| CO4 |   |   |   |   |   | S |   | M |   |   |   |   |   |   |
| CO5 | S |   |   | S |   |   |   |   |   |   |   |   | M |   |

## Unit I

**Introduction to Soft Computing:** Concept of computing systems, "Soft" versus "Hard" computing, Characteristics of Soft computing, Some applications of soft computing techniques.

(04Hrs)

**Fuzzy logic:** Introduction to Fuzzy logic. Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications, and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic

(10 Hrs)

**Artificial Neural Networks**: Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Back Propagation Network, Applications of ANNs to solve some real-life problems

(10 Hrs)

## Unit II

**Genetic Algorithms:** Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, Encoding, Crossover, Selection, Mutation, solving single-objective optimization problems using GA.

(12 Hrs)

**Multi-objective Optimization Problem Solving**: Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

(12 Hrs)

**Recommended Books:**

**Textbooks:**

1. F. Martin, Mc neill, and Ellen Thro, *Fuzzy Logic: A Pratical approach*, AP Professional, 2000.
2. S. Rajasekaran, and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications*, Prentice Hall of India, 2007.
3. D. K. Pratihar, Narosa, *Soft Computing,* 2008.
**Reference Books:**
1. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, *Neuro-Fuzzy and soft Computing,* PHI Learning, 2009.
2. Simon Haykin, *Neural Networks and Learning Machines*, 3rd Edn, PHI Learning, 2011.

## OEIE-911F-MEDICAL IMAGE PROCESSING

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand basics of medical imaging.

**CO 2:** Understand various digitized image functions.

**CO 3:** Use tools and techniques for image quality enhancement.

**CO 4:** Solve thresholding and segmentation problems in medical images.

**CO 5:** Know the applications of image reconstruction techniques.

**PS01:** Apply knowledge to design, analyze and synthesize problems related to Instrumentation and Control Engineering.

**PSO2:** To evolve innovative solutions for real-time and industrial problems using skills, modern tools and recent technologies.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | S | | | |
| CO2 | | M | | | S | W | | | S | | | S | | |
| CO3 | M | | | S | | | | | | M | | M | | |
| CO4 | | | | | S | | M | | | | | | | |
| CO5 | S | | | S | | | | | | S | | | M | |

## Unit I

**Medical imaging systems**: X-rays based imaging systems, Gamma-rays based imaging systems, Ultrasound based imaging systems, MRI

(04 Hrs)

**Digitized Image Functions:** Components of an image processing system, Digital image representation, Image digitization, sampling, Quantization, color images., 2-D Convolution, Fourier transform, 2D-DFT, 2D-DCT, Haar transform

(06 Hrs)

**Image Enhancement:** Image enhancement in spatial domain: Point processing (Identity transformation, Image negative, Brightness and contrast modification, log transformation, Power law transformation, Spatial filtering

Image enhancement in frequency domain: Smoothing filters, sharpening filters, Unsharp masking, High boost filtering, Homomorphic filtering, Notch filters.

(06 Hrs)

**Thresholding and Segmentation:** Detection methods, optimal thresholding, multi-spectral thresholding. Edge based segmentation, Region based segmentation

(06 Hrs)

## Unit II

**Image restoration**: Image degradation/ restoration model, Image noises

(04 Hrs)

**Image compression**: Lossless compression schemes, Lossy compression schemes, Image denoising.

(04 Hrs)

**Image segmentation**: Edge based segmentation, Threshold based segmentation, Region based segmentation, Clustering techniques, Watershed algorithm

(08 Hrs)

**Image Reconstruction:** Image reconstruction from projections, Radon transform, Methods for generating projection data, Types of tomography

(04 Hrs)

**Recommended Books:**

**Textbooks:**
1. John C Russ, *The image processing handbook*, CRC and IEEE press, 1999.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image processing, analysis and machine vision*, 2nd Edition, Brooks Cole publishing Co., 1999.
3. Sid-Ahmed Maher A, *Image Processing Theory, Algorithms and Architecture*, McGraw Hill, 1994.

**Reference Books:**
1. Jayaram, Kudupa and Gabor,T Herman, *3D imaging in medicine*, 2nd Edition, CRC press, 2000.
2. Craig A.Hindley, *Practical image processing in C*, John Wiley and Sons, 1991.
3. R C Gonzalez, Wintz Paul, *Digital Image Processing*, Addision Wesley, 2nd Edition, 1987.
4. A K Jain, *Fundamental of Digital Image Processing*, Prentice Hall, 2002.

## OEIE-911G -SOLAR AND WIND POWER TECHNOLOGIES

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

CO1: Knowledge of Non conventional energy sources especially solar and Wind

CO2: Study of various energy conversion techniques in solar and wind energy.

CO3: Environment and Economical Benefits and challenges with solar and Wind power generation

CO4: Study of wind and solar energy generation scenario in India and world

CO 5: Study of the grid compatibility and integration issues of wind and solar power plants.

| COs | CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | S | | | | | | | | | | S | | |
| CO2 | S | M | | | | W | | | | | W | S | | |
| CO3 | M | | S | | M | S | | M | | | M | | | |
| CO4 | M | | | S | | S | M | | S | S | M | | | |
| CO5 | S | W | M | S | | | | W | M | | | | | |

## Unit I

**Solar Energy-Basic Concepts:** Introduction, The Sun as Source of Energy, The Earth, Sun, Earth Radiation Spectrum, Extra-terrestrial and Terrestrial Radiations, Spectral Power Distribution of Solar Radiation, Depletion of Solar Radiation, Measurement of Solar Radiation, Solar Radiation Data, Solar Time, Solar Radiation Geometry, Solar Day Length, Extra-terrestrial Radiation on Horizontal Surface, Empirical Equations for Estimating Terrestrial Solar Radiation on Horizontal Surface, Solar Radiation on Inclined Plane Surface

(08 Hrs)

**Solar Thermal Systems:** Introduction, Solar Collectors, Solar Water Heater, Solar Passive Space Heating and Cooling Systems, Solar Industrial Heating Systems, Solar Refrigeration and Air Conditioning Systems, Solar Cookers.

(08 Hrs)

**Solar Photovoltaic Systems:** Introduction, Solar Cell Fundamentals, Solar Cell Characteristics, Solar Cell Classification, Solar Cell Technologies, Solar Cell, Module, and Array Construction, Maximizing the Solar PV Output and Load Matching. Maximum Power Point Tracker. Balance of System Components, Solar PV Systems, Solar PV Applications.

(08 Hrs)

## Unit II

**Wind Energy:** Introduction, Basic Principles of Wind Energy Conversion, History of Wind Energy, Wind Energy Scenario – World and India. The Nature of the Wind, The Power in the Wind, Forces on the Blades, Wind Energy Conversion, Wind Data and Energy Estimation, Site Selection Considerations.

(08 Hrs)

**Wind energy systems:** Environment and Economics Environmental benefits and problems of wind energy, Economics of wind energy, Factors influence the cost of energy generation, machine parameters, Life cycle cost analysis.

(06 Hrs)

**Basic Components of a Wind Energy Conversion(WEC) System:** Classification of WEC

systems, Advantages and Disadvantages of WECS, Types of Wind Machines (Wind Energy Collectors), Analysis of Aerodynamic Forces Acting on the Blade, Performance of Wind-machines, Generating Systems, Energy Storage, Applications of Wind Energy, Environmental Aspects

(08 Hrs)

Advancements in Solar and wind Technologies for Grid compatibility and integration.

(02 Hrs)

**Recommended Books:**

**Textbooks:**
1. Earnest , Joshua, *Wind Power Technology*, PHI Learning, New Delhi, 2014
2. Solanki, Chetan Singh, Arora, Brij M., Vasi Juzer, Patil, Mahesh B., *Solar Photovoltaic: A Lab Training Module*, Cambridge University Press, New Delhi, 2009
3. S.P. Sukhatme, J.K.Nayak, *Solar Energy*, Tata McGraw, New Delhi, 2010.
**Reference Books:**
1. Earnest , Joshua and Wizelius, Tore, *Wind Power Plants and Project Development*, PHI Learning, New Delhi, 2011.
2. Partain L.D., Fraas L.M., *Solar Cells and Their Applications*, Wiley, 2nd Ed., New Delhi, 2010.

## OEIE-911H INSTRUMENTATION IN PRECISION AGRICULTURE

| L | T | P | Credits | Weekly Load |
|---|---|---|---------|-------------|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1:** Understand the concept of precision agriculture.

**CO2:** Conduct investigations of complex problems in yield mapping.

**CO3:** Use of modern tools to access to GIS for precision agriculture.

**CO4:** To apply the precision agriculture techniques for achievement of sustainable development goals and for using engineering and technology in the contributions to the society.

**CO5:** To apply the techniques for environment and sustainability.

| COs | CO/PO Mapping: (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| | Programme Outcomes (POs) | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | S | | | | | | | | | | | W | M | S |
| CO2 | | M | | S | S | | | | M | | | | M | S |
| CO3 | | | S | | S | | | | M | | | | M | S |
| CO4 | | | S | | S | S | | | | | M | S | M | S |
| CO5 | | | | | | | S | | | | | | M | S |

## Unit I

**Introduction:** Scope of Precision Agriculture, Terminology and definitions, Overview of precision agriculture technologies, Historic Perspectives of Precision Agriculture, Data management in precision agriculture, impacts on the environment, Applications of precision agriculture. Issues and challenges in precision agriculture

(12 Hrs.)

**Global Positioning Systems:** Overview of Global Positioning systems, Working of GNSS Systems, The GPS segments - the space segment, the control segment, and the user segment. Factors Influencing GPS accuracy and precision, multipath reflections, Hardware for global positioning systems, Differential correction.

(12 Hrs.)

## Unit II

**Sensors:** Sensing Platforms viz. Satellites, Unmanned Aerial Vehicles (UAV), Aerial, Proximal, Electromagnetic Spectrum, Interaction of objects with Electromagnetic radiation, Active and Passive Remote Sensing techniques, Spectral resolution, Spatial resolution, and Temporal Resolution, Soil Sensors, humidity sensors, Weather Sensors, Sensor fusion techniques, Variable rate technologies.

(12 Hrs.)

**Geographic Information Systems:** Introduction to Geographic Information Systems (GIS), Coordinate Systems, Components of GIS, Spatial and Temporal Analysis, Yield mapping, Yield Map Interpretation, Image Classification, Multiband and hyperspectral image fusion techniques.

(12 Hrs)

**Recommended Books:**

**Textbooks:**
1. D. Kent Shannon, David E. Clay, Newell R. Kitchen, *Precision Agriculture Basics*, Print ISBN:9780891183662, Online ISBN:9780891183679, DOI:10.2134/precisionagbasics, American Society of Agronomy Crop Science Society of America Soil Science Society of America.
2. John V. Stafford, *Precision agriculture '19*, 2019, eISBN: 978-90-8686-888-99, ISBN: 978-90-8686-337-2.

**Reference Books:**
1. Pedersen, Soren Marcus, Lind, Kim Martin (Eds.), *Precision Agriculture: Technology and Economic Perspectives*, ISBN 978-3-319-68715-5
2. Ancha Srinivasan, *Handbook of Precision Agriculture: Principles and Applications*, ISBN-13: 978-1560229551, ISBN-10: 1560229551

## PCIE-911 DISSERTATION (PART-1)
## AND PCIE-921 DISSERTATION (PART-2)

|  | L | T | P | Credits | Weekly Load |
|---|---|---|---|---|---|
| PCIE-911 | 0 | 0 | 20 | 10 | 10 |
| PCIE-921 | 0 | 0 | 32 | 16 | 16 |

**Course Outcomes:**

After successful completion of course, the students should be able to

CO1: Have in depth study of the topic assigned in the light of the report to be prepared under programme.

CO2: Review and finalize the approach to the problem relating to the assigned topic.

CO3: Prepare an action plan for conducting the investigation.

CO4: Analysis/Modelling/Simulation/Design/Problem Solving/Experiment.

CO5: Finalize the development of product/process, testing, results, conclusions and future directions.

CO6: Prepare a paper for Conference presentation/Publication in Journals, if possible.

CO7: Preparing a Dissertation in the standard format for being evaluated.

| CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation): | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | Programme Outcomes (POs) | | | | | | | | | | |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | S |  |  |  |  |  |  |  |  |  |  | S |
| CO2 | S | S | M |  |  |  |  |  |  |  |  |  |
| CO3 | M |  |  | S |  |  |  |  |  |  |  |  |
| CO4 |  | S | S | S | S | S |  | M |  |  |  |  |
| CO5 |  |  | S | S |  | S | S |  |  |  |  | S |
| CO6 |  |  |  |  |  |  |  | M |  | S | M |  |
| CO7 |  |  |  |  |  |  |  | S |  | S | S |  |

The object of Dissertation is to enable the student to extend further the investigative study taken up under Instrumentation and Control Engineering, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from Institute/R&D laboratory/Industry. This is expected to provide a good training for the student(s) in research and development work and technical leadership.