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
Website: www.sliet.ac.in

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, and expertise in research methodology, technique and tools.
2. Utilize expertise in designing and analyzing 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 teamwork 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. **Scholarship of Knowledge:** Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.
2. **Critical Thinking:** Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3. **Problem Solving:** Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
4. **Research Skill:** Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5. **Usage of modern tools:** Create, select, learn 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. **Collaborative and Multidisciplinary work:** Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
7. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
8. **Communication:** Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9. **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10. **Ethical Practices and Social Responsibility:** Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11. **Independent and Reflective Learning:** Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

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)

Semester-I							
S. No	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**Hrs**	**Credits**
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**

Semester-II (A)							
Sr. No	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**Hrs**	**Credits**
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**

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

Semester-III							
Sr. No	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**Hrs**	**Credits**
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**

Semester-IV						
Subject Code	**Subject Name**	**L**	**T**	**P**	**Hrs**	**Credits**
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: **paraphrase** the concept of a general measurement system with its functional elements.

CO2: **apply** the fundamentals of instrumentation engineering to choose the appropriate sensor/transducer for measuring the physical quantities like speed, temperature etc.

CO3: **analyze** the various performance of transducers based on various static and dynamic characteristics.

CO4: **compare** the various types of data logger and transmitter based on their working, graphical presentation of data and other parameters.

CO5: **develop** an intelligent instrumentation system by applying the knowledge of material science and instrumentation engineering.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL3	BL4	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

Unit I

Introduction: Concept of generalized measurement system, Static and Dynamic characteristics. Fundamentals of sensors Transducers for various parameters like temperature, pressure, flow, level, acceleration, vibration, orientation etc

(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, photovoltaic cell, photo conductive, photo emissive, fiber optic sensors, concept of smart and intelligent sensor, bio-sensors.

(12 Hrs)

Unit II

Transducers (Part-2): Design of orifice for a given flow condition for compressible and incompressible fluids -Design of rotameter, Design of venturi meter, Design of square root extractors for variable head flow meters. Design of Pressure Sensors: diaphragms, Bourdon gauges, Bellows, Capsules, Factors affecting sensitivity. Design of Temperature Transducers: Design of RTD, materials, tip sensitive & stem sensitive type, Design of Thermister, material, shape, ranges and accuracy specification, Design of Thermocouples, its types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type, Design of Radiation Temperature sensors, its characteristics, types and comparison. Design of Level Sensors: electrical and radiation types

(12 Hrs)

Sensor Fabrication: Design considerations and selection criterion as per standards, Sensor fabrication techniques, process details and latest trends in sensor fabrication. Thick film sensing and system design

(6 Hrs)

Design of Data Acquisition system, Data loggers and transmitters

Design of Microprocessor/microcontroller-based DAS and DATA logger, Two wire and 4 wire transmitters, temperature transmitters, Level transmitters, pressure transmitters, flow transmitters, Design of Smart transmitters.

(6 Hrs)

Recommended Books-

Text Books:

1. Nakra Chowdhary, *Measurement systems application and design*, 4th edition, PHI, McGraw Hill Education India Private Limited, 2016.
2. *DVS Murty, Transducers And Instrumentation*, 2nd edition PHI, McGraw Hill Education India Private Limited, 2012.

Reference Books:

1. Krzysztof Iniewski, *Smart Sensors for Industrial Applications*, 1st edition, Taylor & Francis Ltd, 2017.
2. Clarence W. de Silva, *Sensor Systems: Fundamentals and Applications*, CRC Press; 1st edition, 2016

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

CO1: develop state space models for different systems by using the concept of controllability and observability.

CO2: apply the concept of describing functions for stability analysis of non-linear systems.

CO3: illustrate the implementation of phase plane technique for system analysis.

CO4: compare the Lyapunov's stability method with other methods of system's stability analysis.

CO5: design the adaptive and learning control system by employing the fundamentals of feedback and adaptive control.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL3	BL3	BL2	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	2	2	3	3	3	3	2
CO2	3	3	2	3	3	3	2	1	3	3	3	3	1
CO3	3	3	1	-	-	1	-	1	3	-	1	1	1
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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 learning control systems, On-line and off-line learning control systems.

(12 Hrs)

Recommended Books:

Text Books:

1. B. 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. N. S. Nise, *Control System Engineering*, 6th edition, Wiley Publication, 2010.
2. R. C. Dorf and R. 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: discuss the fundamentals of data transmission, its types and transmission impairment.

CO2: explain the encoding, decoding, modulation, demodulation of signals, and concept of digital data communication.

CO3: compare the multiplexing techniques and types of switching.

CO4: interpret the spread spectrum, frequency hopping and code division multiple access.

CO5: create an error detection and correction algorithm for digital data transmission.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL3	BL5	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	2	2	1	-	1	1	2	3	1	1	2	1
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	3	3	2	2	2	2	3	2	3	3	2
CO5	3	3	3	3	3	3	2	1	3	2	3	3	2

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 to digital (A/D) conversion, Digital to Analog (D/A) 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. A. S. Tanenbaum and D. J. Wetherall, *Computer Networks*, 5th Edition, PHI, 2010.
2. U. D. Black, *Data Communication and Distributed Networks*, PHI, 1999.

Reference Books:

3. B. A Ferouzan, *Data Communication and networking*, McGraw-Hill, 2007.
4. W. 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: compare the microprocessors with microcontrollers based on their functioning, hardware, and software characteristics.

CO2: illustrate the architecture of 8051 with the layout of memory maps, counters, timers and ALU.

CO3: write an assembly language program of 8051 to perform various tasks such as arithmetic operations, add delay, generate different waveforms etc.

CO4: apply the knowledge to interface the external memory, ADC, DAC, displays and sensors with microcontroller.

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

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL5	BL3	BL6	BL3	BL3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	3	2	3	3	2	3	3	2
CO2	3	3	1	-	-	1	1	3	3	-	1	2	1
CO3	3	3	3	2	3	3	2	3	3	2	3	3	2
CO4	3	3	3	3	2	2	2	3	3	2	3	3	2
CO5	3	3	3	3	3	3	2	2	3	2	3	3	2

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. J. B. Peatman, *Design with Microcontroller*, Prentice Hall, 1997.
2. K. 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. M. A. Mazidi and J. G. 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: discuss the social, economical and technical aspects of air pollution.

CO2: analyze how the pollution affects the economy of a country.

CO3: interpret the harmful effects of air, water, noise pollution and rules set up for their control.

CO4: summarize the most common industrial pollutants and their treatment mechanism as per the Indian Standards.

CO5: choose the appropriate pollution control method for process industries, such as fertilizer industries, petrochemical industries, alcohol industries, pulp and paper industries.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL4	BL3	BL2	BL5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	3	3	2	3	3	2
CO3	3	3	2	1	1	2	1	1	3	2	2	2	1
CO4	3	2	1	-	1	1	-	2	3	-	1	2	1
CO5	3	3	3	3	2	2	2	2	3	3	3	3	2

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, M. 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

CO1: summarize the current energy scenarios of India in comparison to that of other countries.

CO2: analyze the features of Hydro-power plants and discuss its turbine types and speed governing techniques.

CO3: illustrate the construction and working of steam power plants and nuclear power plants.

CO4: identify the need of measurement & instrumentation in power plants for controlling various processes and pollution monitoring.

CO5: select an appropriate control strategy for regulating the air/fuel ratio, furnace draft, steam temperature, drum level etc.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL4	BL3	BL2	BL5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	3	1	-	1	3	2	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	1	-	1	2	1	1	3	-	2	2	1
CO4	3	3	2	1	1	2	-	1	3	1	1	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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. M. 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. K. C Lish, *Nuclear Power Plant System and Equipment*, Industrial Press, 1972.
3. E. A. 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: identify the need of signal conditioning and data acquisition circuits for specific measurement systems.

CO2: discuss the various design parameters for signal conditioning and data acquisition circuits and explain its advantages and disadvantages.

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

CO4: analyze the performance of signal conditioning and data acquisition systems by applying the real-time signals.

CO5: design a suitable signal conditioning and data acquisition circuit to meet the practical applications.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL3	BL3	BL4	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	3	1	-	1	3	2	1	2	1
CO2	3	3	3	2	1	2	2	1	3	3	3	3	1
CO3	3	3	1	-	1	2	1	1	3	-	2	2	1
CO4	3	3	2	3	2	3	1	2	3	3	3	3	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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. A. K. Sawhney, P. Sawhney, *A course in Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai & Company, 2016.
2. J. Park, A. S. J. Park, S. Mackay, *Practical data acquisition for instrumentation and control systems*, Newnes, 2003.
3. R. A. Gayakwad, *Op-amps and linear integrated circuits*, Prentice-Hall, Inc, 2007.

Reference Books:

4. H. S. Kalsi, *Electronic Instrumentation*, 3e. Tata McGraw-Hill Education; 2018.
5. R. F. Coughlin and F. F. Driscoll, *Operational Amplifiers and Linear Integrated Circuits*, PHI/Pearson, 2006.
6. J. 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

CO1: recall the basic aspects of statistics, probability and random variables for application in stochastic and random processes.

CO2: solve the problems of one and two random variables by applying the knowledge of random variables and probability distributions.

CO3: explain the concept of stochastic processes and its application to the field of telecommunication and related problems.

CO4: apply the concept of spectrum estimation to predict the outcome of random and stochastic processes.

CO5: formulate a model for the analysis of random processes by using the fundamentals of estimation functions, predictors, and filters.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1	BL6	BL4	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	2	1	1	3	-	2	2	1
CO2	3	3	3	3	3	3	2	2	3	3	3	3	2
CO3	3	3	2	2	1	2	1	1	3	3	3	3	1
CO4	3	2	2	2	2	2	1	2	3	3	3	3	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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. A. 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. H. Stark and J. 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

CO1: describe the basic aspects of energy auditing and management.

CO2: analyze the basic energy management approaches.

CO3: employ the knowledge of energy audit and its application to the field of the various engineering related problems.

CO4: apply the various data gathering and analytical techniques for energy auditing.

CO5: prepare the energy policy planning using modern tools and implement in a real-time problems.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1	BL4	BL3	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2
CO5	3	3	3	3	3	3	1	-	2	3	3	3	1

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

CO1: discuss the various aspects of stability problems in power systems.

CO2: summarize the various methods, like state space representation, modal analysis for evaluating the small signal stability.

CO3: devise numerical solutions for transient stability analysis of power system components.

CO4: apply the fundamentals of numerical methods and engineering for voltage stability analysis.

CO5: develop a model of various power system components for stability analysis.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL2	BL6	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2
CO5	3	3	3	3	3	3	1	-	2	3	3	3	1

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. S. Gupta and K. R. Padiyar, *Topics on small signal stability analysis*, Tata-McGraw hills.
3. P. 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

CO1: explain the concepts of Fuzzy Sets, Feedback Neural Networks, Fuzzy Logic control and their use for controlling real-time systems.

CO2: illustrate the architecture of multivariable fuzzy control with the knowledge of fuzzy inference rules and models of approximate reasoning.

CO3: develop fuzzy control algorithms by applying the knowledge of self-learning with rule based construction.

CO4: summarize the features, design parameters and working of neural network based different fuzzy controllers.

CO5: propose a self-learning based methodology for building the rule-base of a fuzzy logic controller (FLC).

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL4	BL3	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	-	1	1	1	3	-	1	1	1
CO2	3	2	2	3	3	3	1	3	3	1	3	3	1
CO3	3	3	3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	1	2	3	2	1	3	3	3	3	1
CO5	3	3	3	3	3	3	2	1	2	3	3	3	2

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. J. Nie, *Fuzzy- Neural Control: Principles, Algorithms and Applications*, Prentice Hall.
2. V. Rao and H. 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: convert statement of the given optimization problem into a mathematical model.

CO2: interpret the nature of optimization problem in terms of single variable, multivariable, constrained, unconstrained, unimodal, multimodal, single, and multi-objective problem.

CO3: enumerate and **compare** classical and metaheuristic algorithms for solving optimization problem**s**

CO4: solve and **design** real-world optimization problems with the help of studied algorithms

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	CO1	CO2	CO3	CO4
BLs	BL2	BL3	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	-	1	1	1	3	-	1	1	1
CO2	3	3	2	3	3	3	1	3	3	1	3	3	3
CO3	3	3	3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	1	2	3	2	1	3	3	3	3	1

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

Reference Books:

1. S. S. Rao, *Engineering Optimization: Theory and Practice*, 3rd Edition, New Age International (P) Limited, Publisher
2. G. C. Onwubolu, *Emerging Optimization Techniques in Production Planning & Control*, Imperial College Press.
3. Y. H. 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

		CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos			Programme Outcomes (POs)											
	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	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. A. 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

Course Outcomes:

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

CO1: apply adequate knowledge in design of various signal conditioning circuits and instrumentation systems.

CO 2: intervene design knowledge of controller, control valve and transmitter.

CO 3: adapt knowledge of piping diagram of industrial standard.

CO 4: anticipate the students aware of industry project, planning and scheduling.

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	CO1	CO2	CO3	CO4
BLs	BL3	BL6	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	2	3	3	2	3	3	2	3	3	2
CO4	3	3	2	-	-	2	1	1	3	2	-	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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

CO1: describe background and fundamentals of MATLAB tool for the analysis and processing of signals.

CO2: integrate various continuous and discrete time signals.

CO3: prepare an overview of signal transmission through linear systems, convolution and correlation of signals and sampling.

CO4: adapt the concept and importance of Fourier and Z-Transforms.

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	CO1	CO2	CO3	CO4
BLs	BL1	BL6	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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: categorize the classification and modeling of various industrial processes.

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

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

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

CO5: modify core competency of conventional and intelligent controllers used in industries.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL4	BL5	BL4	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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. W. G. Andrew and H. B. Williams, *Applied instrumentation in process industries, Vol. - 1/2/3*, Gulf professional.
4. R. P. Tattamangalam, *Industrial Instrumentation: Principles and Design*, Springer Publication, 2000.

Reference Books:

5. W. 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

CO1: illustrate neuronal, cardiovascular and respiratory system.

CO2: devise working principle of different type of electrodes for biomedical application.

CO3: adapt knowledge of neuromuscular system, generation and sources of brain potential.

CO4: estimate the need and importance of telemedicine in patient monitoring system.

CO5: generalize Electro-Retinogram (ERG), Electro-Occulogram (EOG) and sources of noise in bioelectrical signal recording.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL4	BL6	BL6	BL4	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	2	3	3	3	3	2
CO3	3	2	3	3	3	3	2	3	3	1	3	3	2
CO4	3	3	2	1	1	2	-	-	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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. W. J. Tompkins and W. T. Webster, *Design of Microprocessor based medical instrumentation*, Englewood Cliffs.

Reference Books:

1. J. D. Bronzino, *The Biomedical Engineering Handbook*, 2nd Sub edition, CRC Press, 1999.
2. T. Togawa and T. 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

CO1: identify the importance and classification of telemetry system.

CO2: establish the knowledge of signal transmission techniques, transmitters and receiver.

CO3: dissect the multiplexing, power line carrier and optical fiber communication.

CO4: assess layout, function and operation of Supervisory Control and Data Acquisition (SCADA) system.

CO5: compile the operation of SCADA system and communication between control center and remote terminal units.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL3	BL4	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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 andcombinational 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. E. I. 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. T. Legrell, *Power System Control Technology*, Prentice-hall.

PEIE-821C MULTI-RATE SIGNAL 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

CO1: list the importance and classification of Multirate signals.

CO2: apply the knowledge of Filters.

CO3: analyze the reconstruction filter banks**.**

CO4: classify the various modulation techniques.

CO5: devise the operation of sampling theorem.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1	BL3	BL4	BL4	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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:

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

CO1: classify various power electronics devices such as SCR, TRIAC, IGBT etc.

CO2: assess speed drive, closed loop drive and dual convertor.

CO3: explain the working of frequency control of induction motor drives, braking and variable frequency drive.

CO4: estimate self-controlled synchronous motor operation and its characteristics.

CO5: formulate working principle and application of AC and DC motor drives.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL4	BL5	BL3	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	2	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	-	1	2	1	1	3	2	2	2	-
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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. N. M. Morris, *Industrial Electronics*, 2nd edition, McGraw-Hill, 1978

Reference Books:

3. F. 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

CO1: **visualize** Internet of Things (IoT) and its envisioned deployment domains.

CO2: experiment smart sensors/actuators with their internet connectivity for experimentation and designing systems.

CO3: generalize the various protocol standards deployed in the Internet of Things (IoT) domain and to make informed choices.

CO4: speculate the design and development of IoT systems with enablement ensuring security and assimilated privacy.

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	**CO1**	**CO2**	**CO3**	**CO4**
BLs	BL1	BL2	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	2	-	2	3	3	3	3	1
CO2	3	3	3	3	3	3	-	2	1	3	3	3	1
CO3	3	3	3	3	2	2	2	2	2	3	3	3	3
CO4	3	3	3	3	2	2	2	2	2	3	3	3	3

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. Z. Mahmood, *The Internet of Things in the Industrial Sector*, (Ed.), Springer Publication, 2020
2. S. Misra, C. Roy, and A. Mukherjee, *Introduction to Industrial Internet of Things and Industry 4.0*, CRC Press, 2021
3. S. Jeschke, C. Brecher, H. Song, D. B. Rawat, *Industrial Internet of Things: Cybermanufacturing System*, Springer Publication.
4. I. Butun (editor), *Industrial IoT Challenges, Design Principles, Applications, and Security*.
5. A. Gilchrist, "*Industry 4.0: The Industrial Internet of Things*", Apress 1st ed. Edition, 2017.
6. J. Biron & J. 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

CO1: identify about the basics of digital signal processing and its real-time significance.
CO2: compile knowledge about the Digital Signal Processor (DSP) and its building blocks.
CO3: develop the Architecture of Programmable DSP and On-chip Peripherals.
CO4: Infer the basic algorithms of DSP.
CO5: evaluate about the DSP applications in instrumentation.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL6	BL6	BL6	BL4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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: **illustrate** optimal control problems, their classification along with performance indices and their selection.

CO2: **assess** Lagrange multiplier, Euler Lagrange equation, Transversality condition, equality & inequality constraints for optimization problems.

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

CO4: **apply** various iterative methods of optimization on kalman filter design

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

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
BLs	BL2	BL5	BL3	BL3	BL2

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	2	1	1	2	1	1	3	2	2	2	1
CO3	3	1	2	-	1	2	2	2	2	1	2	3	2
CO4	3	2	2	1	2	3	1	2	2	2	-	2	3
CO5	3	3	2	3	1	3	2	2	3	3	3	3	2

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 multistage 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. A. P. Sage and C. C. White, *Optimum Systems Control*, 2nd edition Prentice-Hall, 1997.
2. B. D. O. Anderson and J. 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

CO1: differentiate electromagnetic and electrostatic fields in terms magnetic flux, electric flux, magnetic field, electric field and maxwell equations.

CO2: assess computer added design **(**CAD) software package and its features for design problems.

CO3: analyze finite difference method in time domain by using CAD software.

CO4: compute finite element for various 3D and 2D geometrical shapes using CAD software.

CO5: design low frequency electrical machines such as rotating machines (both ac and dc), transformers and actuators in CAD software by utilizing finite element method.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
BLs	BL2	BL5	BL4	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	1	1	2	1	1	3	2	2	2	1
CO2	3	3	3	3	3	3	1	-	2	3	3	3	1
CO3	3	3	3	3	2	2	2	2	3	1	3	3	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2
CO5	3	3	2	3	1	3	2	2	3	3	3	3	2

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, Variationaland 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. J. M. Jin, *The Finite Element method in Electromagnetics*, John Wiley & Sons, 2014.
2. M. V. K. Chari and P. 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. P. 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

CO1: describe control system architecture in terms of SISO, MIMO, convexity and duality using state space model.

CO2: analyze the reliability, robustness, sensitivity and stability of closed loop control systems using gain bounds.

CO3: design compensators and controllers for real-world applications using Bode plots and root locus techniques.

CO4: construct closed loop SISO, MIMO and non-linear systems using state variable method

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	**CO1**	**CO2**	**CO3**	**CO4**
BLs	BL2	BL4	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	2	2	2	2	3	1	3	3	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2

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-lag and 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 Feedback 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 systems and software.

(12 Hrs)

RECOMMENDED BOOKS:

Textbooks:

1. M. Gopal, *Control Systems- Principle & Design*, 4th edition, Tata McGraw-Hill, 2012.
2. J. J. D'Azzo, *Linear Control Analysis & Design*, 3rd edition, McGraw-Hill, 1988.

Reference Books:

1. J. A. Borrie, *Modern Control Systems- A manual of Design Methods*, Prentice Hall International.
2. S. P. and C. 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

CO1: explain mathematical concepts behind the single and multi layer artificial neural networks (ANN).

CO2: design controllers for practical applications using fuzzy set theory.

CO3: assess evolutionary computation algorithms for controller design

CO4: construct an intelligent controller such fuzzy controller, neuro controller and evolutionary controllers.

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	**CO1**	**CO2**	**CO3**	**CO4**
BLs	BL2	BL6	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	2	-	1	2	2	2	2	2	2	2	1
CO2	3	3	2	3	3	3	1	-	2	3	3	3	1
CO3	3	3	3	3	2	2	2	2	3	1	3	3	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2

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. R. Jang, *Soft Computing*, PHI
2. D. Driankov, H. Hellendoorn and M. Reinfrank, *Introduction to Fuzzy Control*, Springer-Verlag, 2001.

Reference Books:

1. K. Passino, *Biomimicry for Optimization, Control, and Automation*, Springer-Verlag, London, UK, 2005

2. S. P. and C. 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

CO1: describe the fundamental theory and concepts of machine learning and artificial intelligence algorithms.

CO2: construct artificial neural networks, neuro-modeling, and their applications to pattern recognition.

CO3: assess the learning paradigms of supervised and unsupervised shallow/deep neural networks.

CO4: apply tensor flow software for real-world applications of machine learning algorithms

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	**CO1**	**CO2**	**CO3**	**CO4**
BLs	BL2	BL6	BL5	BL3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	1	-	2	3	3	3	1
CO3	3	3	3	3	2	2	2	2	3	1	3	3	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2

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-Eigenvalues, 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 Feedforward 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. B. Yoshua, I. J. Goodfellow, and Aaron Courville, *Deep learning*, 2015, MIT Press
2. J. Patterson and A. Gibson, *Deep Learning- A Practitioner's Approach,* O'Reilly Media Inc., 2017, USA.
3. O. 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. B. Yoshua, *Learning deep architectures for AI- Foundations and trends in Machine Learning*, 2(1)- 2009.
4. T. 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.

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1				3									
CO2					3								
CO3								3					
CO4						3							
CO5							3						

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 and Educational 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 Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

(12Hrs)

Unit- IV

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner 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. S. N. Busi, 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

CO1: **apply** the knowledge observe neuronal, cardiovascular and respiratory system.

CO2: express working principle of different type of electrodes for biomedical application.

CO3: explain neuromuscular system, generation and sources of brain potential.

CO4: justify the need and importance of telemedicine in patient monitoring system.

CO5: analyze electro-retinogram (ERG), electro-occulogram (EOG) and sources of noise in bioelectrical signal recording.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL3	BL6	BL4	BL5	BL4

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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. W. J. Tompkins and W. T. Webster, *Design of Microprocessor based medical instrumentation*, Englewood Cliffs.

Reference Books:

3. J. D. Bronzino, *The Biomedical Engineering Handbook*, 2nd Sub edition, CRC Press, 1999.
4. T. Togawa and T. 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

CO1: **illustrate** the knowledge of simulation concepts.

CO2: judge the transient behavior of basic signals used in electrical and instrumentation engineering.

CO3: formulate the simulation of engineering problems related to electrical, control, and instrumentation engineering.

CO4: justify the need for and importance of simulation and modelling.

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	CO1	CO2	CO3	CO4
BLs	BL4	BL5	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	2	1	1	2	1	1	3	2	2	2	1

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

CO1: **explain** their work effectively through writing and presentation.
CO2: **propose** research based knowledge in the latest area of technology.
CO3: **persuade** independent and life-long learning
CO4: **assess** the project requiring individual skills.

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	**CO1**	**CO2**	**CO3**	**CO4**
BLs	BL2	BL6	BL5	BL5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	-	1	2	1	1	3	2	2	2	1
CO2	3	3	3	3	3	3	1	-	2	3	3	3	1
CO3	3	3	3	2	2	2	2	2	3	1	3	2	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2

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

CO1: enumerate evolution of 8086 microprocessor architecture & types of microprocessors.
CO2: create assembly language programs of 8086 microprocessor.
CO3: analyze the details of subroutines and addressing techniques of 8086 microprocessor.
CO4: assemble interfacing of 8086 microprocessor with various peripheral devices.
CO5: summarize application of 8086 microprocessor in various areas.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
BLs	BL1	BL6	BL4	BL6	BL5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	1	1	1	2	1	1	3	2	2	2	1
CO2	3	3	3	3	3	3	1	-	2	3	3	3	2
CO3	3	3	3	-	2	2	2	2	3	1	3	2	3
CO4	3	3	3	3	3	3	2	-	3	3	3	3	2
CO5	3	3	2	3	1	3	2	2	3	3	3	3	2

Unit I

Architecture of Microprocessor: Introduction to evolution of microprocessors, 8086architecture; 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 8086 microprocessor, 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. D. V. Hall, *Microprocessors and Interfacing, Programming and Hardware*, TMH, 1992.

Reference Books:

1. B. B. Brey, *The Intel Microprocessor 8086, 80186, 80286, 80386, 80486, Pentium: architecture, programming & interfacing*, PHI,2008.
2. B. 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

CO1: explain basics rules and ethics of robotics and kinematics of robotics.
CO2: describe basics of sensors used for various robotic applications.
CO3: evaluate the control of robots and different end effectors both mechanical and magnetic.
CO4: design programs for robot using various programming languages.
CO5: summarize the application of robotics in various fields and future of robotics.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
BLs	BL2	BL2	BL4	BL6	BL5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	1	1	2	1	1	3	2	2	2	1
CO2	3	2	1	-	-	1	-	1	3	2	2	2	1
CO3	3	3	3	3	3	2	2	2	3	1	3	3	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2
CO5	3	3	2	3	1	3	2	2	3	3	3	3	2

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. R. D. Klafter, T. A. Chmielewski and M. Negin, *Robot Engineering an Integrated Approach*, Prentice Hall, 2009.
2. Y. Koren, *Robotics for Engineering*, McGraw-Hill, 1985.

Reference Books:

1. M. P Groover & N. G Odrey, M. Weiss, R. N Nagel, A. Dutta, *Industrial Robotics, Technology programming and Applications*, McGraw Hill, 2012.
2. J. 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

CO1: recall the fundamental properties of light and basics of optical components.
CO2: categorize the different applications of laser and fiber optics.
CO3: correlate the characteristics, design architectures and trade-offs of semiconductor lasers.
CO4: assess architectures and trade-offs of optical detectors and modulators of light.
CO5: describe fundamental theory of fiber optics and holography.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
BLs	BL1	BL4	BL4	BL5	BL1

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	1	1	2	1	1	3	2	2	2	1
CO2	3	3	3	3	-	3	1	-	2	3	3	3	1
CO3	3	3	3	3	2	2	2	2	3	1	3	3	3
CO4	3	3	2	3	3	3	2	-	3	3	3	3	2
CO5	3	3	2	3	1	3	2	2	3	3	3	3	2

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

Reference Books:

1. J. Gowar, *Optical Electronics*, Prentice Hall, 1993.
2. G. 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: d**evelop** concepts and methodologies for parameter identification tools.

CO2: **estimate** parameters various parameter estimation methods and algorithms.

CO3: **compare** multivariable systems (MVS) and closed loop systems.

CO4: **recognize** the model structure, models, order selection, validation and experiment design.

Mapping COs/Bloom's Taxonomy Level (BLs)				
COs	**CO1**	**CO2**	**CO3**	**CO4**
BLs	BL3	BL4	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	1	1	2	1	1	3	2	2	2	1
CO2	3	3	3	2	3	3	1	-	2	3	3	3	1
CO3	3	3	3	3	2	2	2	2	3	1	3	3	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2

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. T. Kailath, *Linear Estimation*, Prentice Hall, 2000.
2. H. W. Sorensen, *Parameter Estimation: Principles and Problems (Control and Systems Theory)*, vol. 9, Marcel Dekker Inc., 1980.

Reference Books:

1. D. Graupe, *Identification of Systems*, Van Nostrand.
2. L. 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

CO1: **illustrate** the basics of Artificial Intelligence (AI) and human intelligence.

CO2: **analyze** regression and clustering algorithms on medical diagnosis data and case studies.

CO3: **simulate** supervised, unsupervised and bio-inspired AI techniques for dimension reduction or feature identification of medical diagnosis data.

CO4: **assess** the AI algorithms for disease diagnosis and health care.

CO5: **tabulate** the various ethical, legal, and social issues of AI in medicine.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
BLs	BL2	BL4	BL6	BL5	BL1

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	**Programme Outcomes (POs)**												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	1	3	2	3	3	3	2
CO3	3	3	3	3	2	2	2	2	3	1	3	3	3
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2
CO5	3	3	2	3	1	3	2	2	3	3	3	3	2

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: illustrate microprocessor, micro-controllers and 8051 micro-controller architecture.

CO2: create basic assembly language programs for different applications based on the understanding of the basic programming.

CO3: generalize the design of 8051 microcontroller, memory details, subroutines and serial data for different applications.

CO4: simulate microcontroller programs using modern simulators.

CO5: develop practical design of embedded systems using programmable logic device(PLD), FPGA architecture etc.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL6	BL2	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	2	3	3	2	3	3	2
CO4	3	3	3	3	3	3	2	3	3	2	3	3	2
CO5	3	3	3	3	3	3	2	3	3	2	3	3	2

Unit I

Introduction: Microprocessor, Micro-controllers and their comparison.

(06 Hrs)

The 8051 Architecture: Introduction, 8051 microcontroller 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), multipleinterrupts,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. J. B. Peatman, *Design with Microcontroller*, Prentice Hall, 1997.
4. K. 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. M. A. Mazidi and J. G. 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

CO1: describe the basic aspects of energy audit and management.

CO2: analyze the basic energy management approach.

CO3: employ the knowledge of energy audit and its application to the field of the various engineering related problems.

CO4: apply various data gathering and analytical techniques of energy audit.

CO5: prepare the energy policy planning using modern tools and implement in real life problems.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1	BL4	BL3	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	3	3	2	3	3	2
CO3	3	3	3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2
CO5	3	3	3	3	3	3	1	-	2	3	3	3	1

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

CO1: paraphrase the knowledge of virtual instrumentation and measurement systems.
CO2: apply LabVIEW software for data acquisition and system control applications.
CO3: practice hand-on exercises with Plug-in DAQ board and devices.
CO4: simulate programs on LabVIEW platform for implementing small projects.
CO5: develop prototype of different applications using Virtual Instrumentation.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL3	BL3	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	2	2	2	2	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	2	3	3	2
CO5	3	3	3	3	3	3	2	3	3	2	3	3	2

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*, 2nd edition,ISA,1994.

Reference Books:

1. G. W. Johnson, *LabView Graphical Programming*, McGraw Hill, 1997.
2. R. Jamal and H. 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

CO1: enumerate the basic aspects of industrial safety.

CO2: connect the safety standards to industries where safety is prioritized.

CO3: generalize the basic principles of machine guarding.

CO4: apply various analytical techniques of safety measurements in machinery of different stages of industries like welding, gas cutting, boilers etc.

CO5: conclude about the safety of different industries by inspection and testing.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1	BL4	BL2	BL3	BL5

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	1	1	2	1	1	3	2	2	2	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	1	-	-	1	-	1	3	-	1	1	1
CO4	3	3	3	3	3	3	2	1	3	3	3	3	2
CO5	3	3	3	3	2	2	2	2	3	3	3	3	1

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. J. V. Grimaldi and R. 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

CO1: describe different soft computing techniques and its applications.

CO2: discuss soft computing techniques like fuzzy logic, artificial neural networks and genetic algorithms and its applications.

CO3: simulate optimization problems using GAs and Evolutionary algorithms.

CO4: analyze the results of solutions obtained using different soft computing techniques.

CO5: apply soft computing techniques to solve problems in varieties of application domains.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1	BL2	BL3, BL6	BL4	BL3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	2	2	-	-	1	-	1	3	-	1	1	1
CO3	3	3	3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	3	3	3	2	3	3	2	3	3	2
CO5	3	3	3	3	3	3	2	1	3	3	3	3	2

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, M. Neill, and E. 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. S. 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

CO1: reproduce medical image analysis theory, techniques, analysis and applications

CO2: develop research planning and designing skills, incorporating medical image analysis

CO3: apply tools and techniques for image quality enhancement, thresholding and segmentation problems etc. in medical images.

CO4: interpret the relevant medical image analysis data for research to clinical applications

CO5: justify the application of different modern tools for the research and application in medical applications.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1	BL3, BL6	BL3	BL3	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	1	3	3	3	3	2
CO4	3	3	3	3	2	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3

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. J. C Russ, *The image processing handbook*, CRC and IEEE press, 1999.
2. M. Sonka, V. Hlavac, Roger Boyle, *Image processing, analysis and machine vision*, 2nd Edition, Brooks Cole publishing Co., 1999.
3. M. A. S. Ahmed, *Image Processing Theory, Algorithms and Architecture*, McGraw Hill, 1994.

Reference Books:

1. J. K. Udupa and G. T. Herman, *3D imaging in medicine*, 2nd Edition, CRC press, 2000.
2. C. A. Hindley, *Practical image processing in C*, John Wiley and Sons, 1991.
3. R. C. Gonzalez, W. 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: explain the non conventional energy sources especially solar and wind.

CO2: describe the various energy conversion techniques in solar and wind energy.

CO3: anticipate the environment and economical benefits and challenges with solar and wind power generation.

CO4: generalize wind and solar energy generation scenario in India and world.

CO5: speculate the viability of wind and alternative energy projects by understanding the grid compatibility and integration issues of wind and solar power plants.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL1	BL6	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	1	-	1	3	-	1	1	1
CO2	3	3	1	-	-	1	-	1	3	-	1	1	1
CO3	3	3	3	3	3	3	1	-	2	3	3	3	1
CO4	3	3	3	3	2	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	3	3	3	3	2

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**.** J. Earnest, *Wind Power Technology*, PHI Learning, New Delhi, 2014

2. C. S. Solanki, B. M. Arora, V. Juzer, M. B. Patil, *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**.** J. Earnest and T. Wizelius, *Wind Power Plants and Project Development*, PHI Learning, New Delhi, 2011.

2. L. D. Partain, L. M. Fraas, *Solar Cells and Their Applications*, Wiley, 2nd Ed., New Delhi, 2010.

OEIE-911 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

CO1: discuss the concept of precision agriculture and engineering solutions.

CO2: plan investigations of complex agricultural problems in yield mapping.

CO3: apply modern tools to access Global Positioning systems for precision agriculture.

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

CO5: integrate the precision agricultural techniques to traditional techniques for balanced environment and sustainability.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1, BL2	BL6	BL3	BL6	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	-	1	3	-	1	1	1
CO2	3	3	3	3	3	3	2	1	3	3	3	3	2
CO3	3	3	3	3	3	3	2	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	2	3	3	2
CO5	3	3	3	3	2	2	2	2	3	3	3	3	3

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. K. Shannon, D. E. Clay, N. 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. J. V. Stafford, *Precision agriculture '19*, 2019, eISBN: 978-90-8686-888-99, ISBN: 978-90-8686-337-2.

Reference Books:

1. S. M. Pedersen, K. M. Lind, (Eds.), *Precision Agriculture: Technology and Economic Perspectives*, ISBN 978-3-319-68715-5
2. A. 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: review the available literature to finalize the research area and approach to the problem relating to the topic.

CO2: prepare an action plan for conducting the investigation.

CO3: select an appropriate approach for Analysis/Modeling/Simulation/Design/Problem Solving/Experiment.

CO4: device the development of product/process, testing, results, conclusions and future directions.

CO5: prepare a Dissertation, journal manuscript, and conference paper in the standard format.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL3	BL5	BL5	BL6

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):													
COs	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	1	1	-	1	1	3	2	1
CO2	3	3	3	3	3	2	2	1	3	3	3	3	2
CO3	3	3	3	3	3	2	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	2	1	3	3	3	3	3
CO5	3	3	3	3	3	3	2	1	3	3	3	3	3

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.