SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

Vision of the 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 of the Department

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 (POs)

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.

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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-911H	Instrumentation in Precision Agriculture

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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: **iscuss** 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.

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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 problems

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, -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.

Note : To be changed whole syllabus

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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. (12 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. (12 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.

(12 Hours)

Cosine Modulated filter banks: Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase distortion- Closed form expression- Polyphase structure- PR Systems. (12 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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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

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1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.

SLIET LONGOWAL

1.2.3 -INSTRUMENTATION AND CONTROL ENGINEERING (PG-ICE)

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.