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 need 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 Promotion of holistic development among the students
4. To provide extension services to rural society, industry professionals, institutions of research and higher learningthe 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 graduates of Instrumentation and Control Engineering should be able to demonstrate

1. skill in professional / academic career using the knowledge of mathematical, scientific and engineering principles.
2. expertise in solving real life problems, designing innovative products and systems that are techno-economically and socially sustainable.
3. (5) professional ethics and commitment organizational goals
4. (4) Leadership and team work while working with diverse multidisciplinary / interdisciplinary groups.
5. (3) 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 Graduates of the Sant Longowal Institute of Engineering & Technology, Deemed University, Longowal will have ability to:

1. apply knowledge of mathematics, science and engineering principles to solve complex Instrumentation and Control engineering research and industrial problems.
2. identify, formulate and analyze the research and real life problems using principles of mathematics, natural sciences and engineering.

3. design solutions for Instrumentation and Control engineering problems or processes that meet the specified needs of public health, safety, cultural, societal, environmental considerations etc.
4. use scientific and technical knowledge for design and analysis of experiments
5. create, select, and apply recent techniques, resources, and modern engineering and IT tools for modeling engineering system
6. think logically, analytically and apply reasoning in the contextual knowledge to assess societal, health, safety, legal cultural issues etc.
7. understand the environmental and societal issues and suggest sustainable solutions.
8. commit to professional ethics, responsibilities and norms of the engineering practice.
9. function as effective member individually as well as team leader in multidisciplinary and diverse teams.
10. communicate and present technical knowledge effectively in oral and written forms.
11. demonstrate knowledge and understanding of project engineering and management
12. recognize the need and prepare for lifelong learning.

SCHEME
of
Bachelor of Engineering
Instrumentation and Control Engineering

DEPARTMENT OF ELECTRICAL AND INSTRIUMENTATION ENGINEERING

FOUR YEAR DEGREE PROGRAM IN INSTRUMENTATION AND CONTROL ENGINEERING

Semester-I (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CYT-411	Applied Chemistry	3	1	0	4	3.5
2	HUT-412	Engineering Economics and Entrepreneurship	3	1	0	4	3.5
3	CST-411	Elements of Computer Programming	2	0	0	2	2
4	ECT-411	Elements of Electronics Engineering	3	1	0	4	3.5
5	MET-412	Workshop Technology & Practices-I	2	0	0	2	2
6	CYP-411	Applied Chemistry	0	0	2	2	1
7	CSP-411	Elements of Computer Programming	0	0	2	2	1
8	ECP-411	Elements of Electronics Engineering	0	0	2	2	1
9	MEP-413	Engineering Drawing*	1	0	2	3	2.5
10	WSP-412	Workshop Technology & Practices-I	0	0	4	4	2
		Total	14	3	13	30	22
		*ME-452 is a practical Subject only with LTP:1-0-3					

Semester-II B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-421	Engineering Mathematics	4	1	0	5	
2	PHT-421	Applied Physics	3	1	0	4	
3	HUT-422	English communication and Soft Skills	3	0	0	3	
4	EET-421	Elements of Electrical Engineering	3	1	0	4	
5	MET-422	Elements of Mechanical Engineering	3	1	0	4	
6	PHP-421	Applied Physics	0	0	2	2	
7	HUP-422	English communication and Soft Skills	0	0	2	2	
	EEP-421	Elements of Electrical Engineering	0	0	2	2	
	MEP-422	Elements of Mechanical Engineering	0	0	2	2	
		Total	16	4	8	28	

Semester-II B (UG:Practical Training)

		In House Industrial Training (Two Weeks)					2

Semester-III B.(UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	IET-511	Linear Integrated Circuits	3	1	0	4	3.5
2	IET-512	Measurement Sciences	3	1	0	4	3.5
3	IET-513	Digital Electronics	3	2	0	5	4
4	IET-514	Circuit Theory	4	1	0	5	4.5
5	IET-515	Industrial Instrumentation-I	4	1	0	5	4.5
6	IEP-511	Linear Integrated Circuits Lab	0	0	2	2	1
7	IEP-513	Digital Electronics Lab	0	0	2	2	1
8	IEP-515	Industrial Instrumentation-I	0	0	2	2	1
9	IEP-516	Instrumentation Workshop	0	0	2	2	1
		Total	17	6	8	29	24

Semester-IV B.(UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-521	Higher Engineering Mathematics	4	2	0	6	5
2	IET-521	Signals and Systems	3	1	0	4	3.5
3	IET-522	Electrical and Electronics Measurement	4	1	0	5	4.5
4	IET-523	Control Engineering	4	1	0	5	4.5
5	IET-524	Industrial Instrumentation-II	3	1	0	4	3.5
6	IEP-522	Electrical and Electronics Measurement Lab	0	0	2	2	1
7	IEP-523	Control Engineering Lab	0	0	2	2	1
8	IEP-524	Industrial Instrumentation-II Lab	0	0	2	2	1
		Total	18	6	6	30	24

Semester-V B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	IET-611	Microprocessor and Applications	4	0	0	4	4
2	IET-612	Analytical and Optical Instrumentation	3	0	0	3	3
3	IET-613	Non Linear and Discrete Control System	3	1	0	4	3.5
4	IET-614	Process Dynamics and Control	3	1	0	4	3.5
5	IET-615	Telemetry and Data Acquisition System	3	0	0	3	3
6	IET-61*	Elective-1	4	0	0	4	4
7	IEP-611	Microprocessor and Applications Lab	0	0	2	2	1
8	IEP-612	Analytical and Optical Instrumentation Lab	0	0	2	2	1
9	IEP-614	Process Dynamics and Control Lab	0	0	2	2	1
		Total	20	2	6	28	24

Semester-VI B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-621	Numerical Analysis	3	1	0	4	3.5
2	IET-621	Microcontroller and Embedded Systems	3	1	0	4	3.5
3	IET-622	Computer Control of Processes	3	1	0	4	3.5
4	IEO-62*	Open Elective-1	3	0	0	3	3
5	IET-62*	Open Elective-1	4	0	0	4	4
6	IET-623	Biomedical Instrumentation	3	1	0	4	3.5
7	AMP-621	Numerical Analysis Lab	0	0	2	2	1
8	IEP-621	Microcontroller and Embedded Systems Lab	0	0	2	2	1
9	IEP-623	Biomedical Instrumentation Lab	0	0	2	2	1
		Total	19	4	6	29	24

Semester- VII B (UG:Industrial Training)

		Industrial Training (6 WEEKS)					8

Semester-VII B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	HUT-712	Human Values and Professional Ethics	2	0	0	2	2
2	IEO-71*	Open Elective-2	3	0	0	3	3
3	PHT-711	Physics of Materials	3	1	0	4	3.5
4	IET-71*	Elective-3	4	0	0	4	4

5	IET-711	Digital Signal Processing	3	0	0	3	3
6	IET-712	Process Plant Instrumentation	4	0	0	4	4
7	PHP-711	Physics of Materials	0	0	2	2	1
	IEP-711	Virtual Instrumentation Lab	0	0	2	2	1
	IEP-712	Minor Project	0	0	4	4	2
		Total	19	1	8	28	23.5

Semester-VIII B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CHT-721	Environmental Studies	3	0	0	3	3
2	HUT-722	Principles of Management	3	1	0	4	3.5
3	IEO-72*	Open-Elective-3	3	0	0	3	3
4	IET-72*	Elective-4	4	0	0	4	4
5	IEP-721	Major Project	0	0	8	8	4
6	IEP-722	Seminar	0	0	2	2	1
7	IEP-723	Self Study Course(Inst. And Control Engg.)	0	0	0	0	1
		Total	13	1	10	24	19.5
			CreditsTotal			182	

Elective-I

IET-616	Environmental Instrumentation	4	0	0	4	4	
IET-617	Robotics	4	0	0	4	4	
IET-618	Building Automation	4	0	0	4	4	
IET-619	Data Communication and Networking	4	0	0	4	4	

Elective-II

IET-624	Industrial Safety Engineering	4	0	0	4	4
IET-625	Machine Design	4	0	0	4	4
IET-626	Energy Management and Auditing	4	0	0	4	4
IET-627	Reliability Engineering	4	0	0	4	4

Elective-III

IET-713	Image Processing	4	0	0	4	4
IET-714	Introduction to MEMS	4	0	0	4	4
IET-715	Biomedical Signal Processing	4	0	0	4	4
IET-716	Non-Conventional Energy Sources	4	0	0	4	4

Elective-IV

IET-721	Modelling and Simulation	4	0	0	4	4
IET-722	Electromagnetic Field Theory	4	0	0	4	4
IET-723	Nuclear Instrumentation	4	0	0	4	4
IET-724	Soft Computing	4	0	0	4	4

Open Elective

IEO-621	Industrial Instrumentation	3	0	0	3	3
IEO-711	Analytical Instrumentation	3	0	0	3	3
IEO-721	Biomedical Signal Processing	3	0	0	3	3

SYLLABUS
of
Bachelor of Engineering
Instrumentation and Control Engineering

Subject Code : EET-421
Title of the course : Elements of Electrical Engineering

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

CO1: Apply the knowledge of Electrical Engineering principles to solve D.C and A. C. circuits.
CO2: Formulate and analyze electrical circuits.
CO3: Understand basic principles of electromagnetism to implement in electrical machines and transformers.
CO4: Identify and select various electrical machines according to the applications.
CO5: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

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

Theory:

Unit	Main Topics	Course outlines	Hour(s)
Unit-1	**Basic Elements**	Concepts of Electric Charge, Current and Electromotive force, Potential and Potential Difference; conductor, semiconductor insulator and dielectric, Electrical Power and Energy; Basics of Instruments used for Measuring Current, Voltage, Power and Energy, Methods and precautions in use of these and other instruments e.g. digital multimeters, oscilloscopes, signal generators etc.; Basics of various protection and safety devices e.g. Fuses, Earthing, MCBs and ELCBs	04
	Concepts of DC	Ohm's Law, Resistance, and color coding; Capacitance and Inductance, their ratings; Effects of Temperature on Resistance, Series and Parallel Connection of Resistances and capacitances, Kirchoff's Laws and Their Applications, Network Theorems	04
	AC Fundamentals	Concept of Alternating Voltage and Alternating Current, Difference between AC and DC, Various Terms Related with AC Waves; RMS and Average Values, Concept of Phase Difference and Phasor, Single Phase and Three Phase Supply; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Impedance and Power in AC Circuit.	07
	Three phase AC	Phasor representation of three phases, Star and Delta connections, Inter-Relation between phase and line values of voltage/current, power measurement in three phase system;	06
Unit-2	**Electromagnetic Induction**	Concept of Magnetic Field, Magnetic Flux, Reluctance, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws, Effects on a Conductor Moving in A Magnetic Field, various losses in magnetic	04

		circuits;	
	Electrical Machines	Elementary concepts and classification of electrical machines, Common features of rotating electrical machines, Basic principle of a motor and a generator, Need of Starters and their classifications..	09
	Transformers	Transformer- Classification, Principle of operation, Construction, Working and applications	04
	Basic Troublshooting	Basic Testing and faults diagnosis in electrical systems, various tools and their applications, replacement of different passive components e.g. fuses, lamps and lamp holders, switches, cables, cable connectors, electromagnetic relays.	04

Recommended Books:

1. D P Kothari & I J Nagrath, *Basic Electrical Engineering,* TMH
2. D P Kothari & I J Nagrath, *Electrical Machines*, TMH
3. Edward Hugh, *Electrical Technology*, Pearson Education
4. S K Bhattacharya, *Electrical Machines*, TMH

Subject Code : EEP-421
Title of the course : Elements of Electrical Engineering

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: Apply the knowledge of Electrical Engineering principles to verify D.C and A. C. circuits.

CO2: Formulate and analyze electrical circuits.

CO3: Understand basic characteristics of electromagnetism to proficiently use machines and transformers.

CO4: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

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

To understand the practicability of **Elements of Electrical Engineering**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Study of various passive components and measuring instruments and their connections in electrical circuits.
2. Verification of Ohm's Law.
3. Verification of Kirchoff's current and voltage laws.
4. Verification of equivalent resistances in series and parallel connections.
5. Measurement of voltage, current, phase angle, power and power factor in RL, RC and RLC circuits.
6. Implementation of various types of earthing.
7. Study of various types of protection devices e.g. fuses, Miniature circuit Breaker (MCB) and Earth leakage circuit Breaker (ELCB)
8. Verification of Faraday's laws and Lenz's law.
9. To start the DC and AC motors with various types of starters.
10. Verification of turns ratio of transformer and find the efficiency.
11. Starting and reversing various AC and DC motors.
12. Fault diagnosis and removal in general electrical connection /apparatus.

Subject Code : IET-511
Title of the course : Linear Integrated Circuits

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

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

CO1: Acquire knowledge of operational amplifier, its configuration, analysis and application.
CO 2: Understand the concept of Butterworth filter and other high order filters.
CO 3: Know working principle and different types of oscillators.
CO 4: Learn basic concept and working of comparators and converters.
CO 5: Develop the concept about the specialized IC applications.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** The Operational Amplifier, block diagram representation and analysis, Differential amplifier, buffer, level translator and output driver. Block diagram, specifications, ideal op-amp, emitter coupled differential amplifiers, Various Parameters: Input Offset Voltage, Input Bias Current, CMRR(common mode rejection ratio), SVRR, Differential Input Resistance, slew rate familiarization with 741, offset null adjustments, measurement of op-amp parameters, frequency response op-amp.	08
	Operational amplifier: Ideal Op-Amp, equivalent circuits, configurations, differential amplifier, inverting amplifier, non inverting amplifier, negative feedback, block diagram representation of feedback configurations, Voltage Series Feedback Amplifier, voltage shunt feedback amplifier, Differential Amplifiers, Voltage Follower.	08
	Op-amp linear applications: DC and AC Amplifiers, Summing, Scaling and Averaging Amplifiers, Instrumentation Amplifier, Differential Input and Output Amplifier, V/I converter with grounding and floating load, I/V converter, Integrator and differentiator.	06
	Active filters: Introduction, Butterworth Filter, Higher Order Filters, Band Pass and Band Reject Filters, All Pass filter	06
unit-2	**Oscillators:** Principles, Types, Frequency Stability, Phase Shift, Wein Bridge, Quadrature Oscillators, Square Wave Generator, Triangular Wave Generator, Sawtooth Wave Generator, Voltage Controlled Oscillators.	04
	Comparators: Introduction, Basic Comparator, Zero Crossing Detector, Schmit Trigger, Comparator Characteristics, Limitations of Op-Amps as Comparators, Voltage Limiters	04

	Converters: High Speed and Precision type Comparators,V/F and F/V Converters, Clippers and Clampers, Peak Detector, Sample and Hold Circuit.	06
	Specialized IC applications: Universal Active Filter, Switched Capacitor Filter,555 Timer, Power Amplifiers, Concept of regulation, 723 voltage regulator, three terminal voltage regulators (positive, negative, variables) applications, commercial voltage regulators ICs, universal active filter, switched capacitor filter, phased locked loop.	08

Recommended Books-

1. Choudhury and D. Roy, *Linear Integrated Circuits*, New Age International, 2011.
2. Gayakwad and Ramakant A., *OP-AMPS andLinear Integrated Circuits*.,PHI Learning, 2009.
3. Jacob Millman, Christos Halkias and Chetan D Parikh., *Integrated Electronics: Analog And Digital Circuit Systems,* Mcgraw Hill Education , 2011.
4. Robert F. Coughlin and Frederick F. Driscoll, *Operational Amplifiers and Linear Integrated Circuits*, Prentice Hall , 2000.
5. Albert Malvino and David Bates, Electronic Principles, 7th Edition, Tata McGraw Hill

Subject Code : IET-512
Title of the course : Measurement Sciences

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: understand the basic concept of measurement and generalizedmeasurement system.
CO2: Acquire knowledge of the static and dynamic characteristics of measuring instruments.
CO3: Learn the concept, classification and application of transducer.
CO4: Be conversant withprinciple, working of various transducers and their application

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction to measurements:** Measurements, Significance, classification of the methods of measurement, instruments and measurement systems, types of instruments, elements of a generalized measurement system, input / output configuration of measurement systems, methods of correction for the various inputs.	06
	Static characteristics of the instruments : Measurement system performance, static characteristics in detail, calibration, error in measurement, loading effects, input/ output impedance, loading effects due to series and shunt connected instruments.	04
	Dynamic characteristics of the instruments: Dynamic response and analysis, time and frequency domain analysis, mathematical models of the measurement system, types of systems, dynamic response of the first order and second order instruments to standard inputs, correlation between the time and frequency response.	06
	Errors in measurement and their statistical analysis : Limiting errors, combination of quantities with errors, types of errors, statistical treatment of data, Gaussian curve of errors, Probable error and tables, specifying measurement data, rejection of data, uncertainty analysis., curve fitting	04
unit-2	**Introduction to transducers:** Primary sensing elements and Detectors, Definitions and types of transducers, Characteristics and Choice Of Transducers, Factors Influencing The Choice of Transducers	04
	Resistive and inductive transducers: Construction, working principles, types, applications, advantages and disadvantages of potentiometers and strain gauge, Resistive temperature transducers(RTD), Thermocouples, Thermistors, Basic principles of Variable Inductance Transducers, Electromagnetic pick up, Induction potentiometer, Linear variable differential transformer (LVDT) Variable reluctance	08

	transducers.	
	Capacitive and piezoelectric transducer: Basic principle and uses of piezoelectric transducers, Piezoelectric crystals and their properties, General forms of piezoelectric transducers, Basic principles and types of Variable Capacitance Transducers, frequency response, advantaged disadvantages and uses of capacitive transducers Capacitance pick up, Condenser microphones, Differential capacitor pick up.	08
	Other transducers: Introduction to Digital Transducers, Photo Electric Devices,Load cell, strain gauge and inductive torque meter magnetostrictive transducers electrical tachometers (AC and DC both)	08

Recommended Books-

1. A K Ghosh, *Introduction to Instrumentation and Control,* Prentice Hall of India, 2005.
2. A.K. Sawhney and PuneetSawhney,*A course on electrical and electronic measurements and instrumentation,*DhanpatRai, 2012.
3. David A Bell, *Electronic Instrumentation and measurement*, 3rd edition, Oxford University Press, 2013.
4. John P. Bentley, *Principles of Measurement System*, 3rd edition, Pearson Education, 2000.

Subject Code : IET-513
Title of the course : Digital Electronics

L	T	P	Credits	Weekly Load
3	2	0	4	5

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Exercise various number systems, binary operation and error correction.
CO 2: Interpret Boolean Algebra, encoders, decoders and code conversion.
CO 3: Understand working of Latch, flip-flops, registers, counters and their types.
CO 4: Be conversant in basics of VHDL and design sequential circuit using VHDL
CO 5: Understand digital ICs, logic families, memories and programmable logic arrays.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
unit-1	**Number system & codes:** Review of number systems, binary number systems, octal number system, hexadecimal number system, signed & unsigned numbers, different types of codes & their conversions, binary operations- addition, subtraction, multiplication, division, 1‘s & 2‘s complement of a number.	08
	Combinational logic: Concept of positive & negative logic, introduction to Boolean variables, Logical functions using Karnaugh map &Quine-Macluskey methods, multiplexers, demultiplexers, encoders, decoders, address, subtractors, parity generators, parity checkers, code converter.	08
	Sequential logic concepts and components: Flip flops - SR, JK, D and T flip flops – Level triggering and edge triggering, Shift registers, type of registers, circuit diagrams, synchronous & asynchronous Counters, Excitation tables ,design with state equation state diagram counters, up & down counters, ring counters & mod, Counters. Introduction to finite state machines.	10
unit-2	**Introduction to VHDL:** Overview of digital design with very-high-speed integrated circuits (VHSIC) VHSIC hardware description language (VHDL), HDL format and Syntax, entity, Data representation in VHDL, Truth table using VHDL, Decision Control structure and Sequential Circuit using VHDL.	08
	Digital logic families: Introduction, characteristics of digital ICs, resistor transistor logic, integrated injection logic, direct coupled transistor 109lc, diode transistor logic & transistor-transistor logic, emitter coupled logic, MOS logic, and high threshold logic families.	08
	Semiconductor memories: Introduction, memory organization, classification & characteristics of memories, sequential memories, read only memories, read & write	08

	memories, content addressable memories, and programmable logic arrays, charged coupled device memory.	

Recommended Books-

1. D.P. Kothari and J.S. Dhillon, *Digital Circuits and Design*, Pearson Education, 2016
2. Floyd Thomas S, *Digital Fundamentals*, 10th Edition, Pearson Education, 2013.
3. Jain R.P., *Modern digital Electronics*, Tata McGraw Hill, 1999.
4. Kumar Anand, *Fundamentals of Digital Circuits*, 3rd Edition, Prentice Hall of India, 2014.
5. Malvino Albert Paul, *Principles of Digital Electronics*, 4th Edition, Tata McGraw Hill, 1991.
6. Mano Morris, *Digital Logic and Computer Design*, 2nd Edition, Prentice Hall of India, 1991.
7. Tocci Ronald J. Widmer Neal S. and Moss Gregory L., *Digital Systems: Principles and Applications*, 11th Edition, Prentice Hall of India, 2010

Subject Code : IET-514
Title of the course : Circuit Theory

L	T	P	Credits	Weekly Load
4	1	0	4.5	5

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Identify Circuit components and network graph.
CO 2: Know about the network theorems and two port network descriptions
CO 3: Determine system stability using network stability criteria.
CO 4: Understand the fundamental concepts of network analysis and synthesis of two-port passive networks.
CO 5: learn various characteristics of Attenuators and Filters.

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

Theory:

Unit	Main Topics and Course Outline	Hour(s)
unit-1	**Graph theory:** Graph of a Network, definitions, tree, co tree , link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Node methods of analysis.	08
	Network theorems (Applications to ac networks): Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman's theorem, compensation theorem, Tellegen's theorem.	06
	Network functions: Concept of Complex frequency , Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot, frequency response and Bode plots.	10
Unit-2	**Two port networks:** Characterization of LTI two port networks ZY, ABCD and h parameters, reciprocity and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T & Π Representation.	09
	Network synthesis : Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Caurer first and second forms.	08
	Filters: Image parameters and characteristics impedance, passive and active filter fundamentals, low pass, high pass, band pass, band elimination filters.	07

Reference Books:
1.A.Chakrabarti,*Circuit Theory*, 6thEdition,DhanpatRai Co. , 2010.

2. Donald E. Scott, *An Introduction to Circuit analysis: A System Approach*, New York Mc-Graw Hill, 1987

3.D.RoyChoudhary,*Networks and Systems*, 2nd Edition, New Age International Publication, 2010.

4. M.E. Van Valkenburg, *Network Analysis*, 3rdEdition,Prentice Hall of India/Pearson Education,2002

Subject Code : IET-515
Title of the course : Industrial Instrumentation-I

L	T	P	Credits	Weekly Load
4	1	0	4.5	5

Course Outcomes:

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

CO1: Acquire the knowledge of purpose and scope of instrumentation in Industrial processes.

CO2: Be competent to handle of different types of temperature measuring instruments likeThermistor, Thermocouple etc. and their application in various Industrial processes.

CO3: Be conversant in construction and working various pressure measuring instruments.

CO4: Be conversant in construction and working various flow and level measurement devices used for industrial purposes.

CO6: Understand the calibration of various industrial instruments.

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

Theory:

Unit	Main Topics and Course Outline	Hour(s)
Unit-1	**Temperature measurement:** Temperature scale and conversion, principle of vapor, gas, liquid filled thermo meters, bimetallic thermo meter, pressure spring thermometer, thermocouple and its configuration, extension wires, resistance temperature detector & compensation techniques, Thermistor, Pyrometry- Stefan Boltzmann's law- Black body radiation- Optical radiation pyrometers- Disappearing filament photo electric pyrometer- Unchopped DC and chopped AC broad band radiation thermometers- Two colour radiation thermometers- Pneumatic and electrical temperature transmitters, Digital thermometers.	10
	Pressure measurement: Introduction to static and dynamic pressure, unit of pressure and conversions, differential pressure elements – U tube manometer – inclined manometer- ring balanced type manometer, elastic transducers like ordinary and diaphragm, bourdon tube, bellows, capsules etc. sealed pressure gauges, differential pressure transducers –pneumatic and electrical pressure transmitters, pressure switches and strain gauge pressure pickups, methods for measurement of vacuum Pirani Gauge, Mclead Gauge, Knudsen Gauge, very high pressure measurement, Calibration of pressure instruments	10

Unit-2	**Measurement of flow rate:** Classification of fluid flow, Variable headmeters for incompressible and compressible, Differential pressure meter(primary elements)- theory, construction and applications of orifice plate, venturimeter, flow nozzle, pitot tube, dall tube. Variable area type flow meters, Pressure taps- Manometers, differential pressure measurement- Square root extraction. Magnetic Meter, Turbine Meter, Vortex Meter, Mass Flow Meter. Ultrasonic Meter, Thermal Flow Meter. Positive Displacement Meters. Calibration of floe meters	16
	Level measurement: visual level indicators, differential pressure, ordinary float type, purge method, Buoyancy method, resistance probes for level measurement, capacitive level meter, ultrasonic level measurement, Gamma rays level measurement, microwaves, level limit switches, level measurement of closed vessel. measurement of level of solids- paddle wheel type	12

Recommended Books-

1. Andrew and Williams, *Applied instrumentation in process industries*, Vol. - 1/2/3, Gulf professional.
2. Austin E. Fribance, *Industrial instrumentation fundamentals*, McGraw hill, 1984.
3. B. G. Liptak, *Instrument Engineers Handbook*, Vol- 1, CRC Press, 2003.
4. D. Patranabis, *Principles of industrial instrumentation*, 2nd edition,TMH, 2005
5. E. B. Jones, *Instrument technology*, 3rd edition, Newnes-Butterworths, 1974.
6. Ernest O. Doebelin, *Measurement Systems: Application and Design*, 5th edition, McGraw-Hill Higher Edu., 2003.
7. Fairgeyer&Okun, *Water and Waste Water Technology*, 3rd edition, John Wiley and Sons, 2010.
8. R. K. Jain, *Mechanical and Industrial Measurements*, 12th edition, Khanna Publishers, 2013.

Subject Code : IEP-511
Title of the course : Linear Integrated Circuits Lab

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: Implement operational amplifier in inverting, non-inverting and differential amplifier mode.
CO 2: Understand the implementation of Op-amp as voltage follower and square wave generator.
CO 3: Analyze working of op-amp as different types of filters.
CO 4: Verify operation of 555 timer as astable and monostable multivibrator.
CO 5: Understand operation of op-amp based instrumentation amplifier.

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

To understand the practicability of **Linear Integrated Circuits**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To experimentally study the performance of inverting amplifier-using op-amp.
2. To experimentally study the performance of non-inverting amplifier using op-amp.
3. To experimentally study the performance of differential amplifier using op-amp
4. To demonstrate working of an op-amp as a voltage follower.
5. To demonstrate working of an op-amp as a square wave generator.
6. To demonstrate working of an op-amp as a low pass filter.
7. To demonstrate working of an op-amp as a high pass filter.
8. To demonstrate working of an op-amp as a band pass filter.
9. To demonstrate working of an op-amp as a band rejection filter.
10. To demonstrate the operation of a 555 timer as monostable multivibrator.
11. To demonstrate the operation of a 555 timer as astable multivibrator.
12. To demonstrate working of instrumentation amplifier using 3 op-amp configurations.

Subject Code : IEP-513
Title of the course : Digital Electronics Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Exercise and verify truth tables of TTL gates, universal gates.
CO 2: Design and verify truth tables of Half and Full adder, subtractor circuits.
CO 3: Verify truth tables of Multiplexer 74150 and De-Multiplexer 74154.
CO 4: Design and verify truth tables of S-R (NOR/NAND gates based), J-K and D flip flops
CO 5: Operate counters and design4 bit shift register, modulo-4 counter using J K flip flop

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

To understand the practicability of **Digital Electronics**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Verification of the truth tables of TTL gates.
2. Verify the NAND and NOR gates as universal logic gates.
3. Design and verification of the truth tables of Half and Full adder circuits.
4. Design and verification of the truth tables of Half and Full subtractor circuits.
5. Verification of the truth table of the Multiplexer 74150.
6. Verification of the truth table of the De-Multiplexer 74154.
7. Design and test of an S-R flip-flop using NOR/NAND gates.
8. Verify the truth table of a J-K flip-flop (7476)
9. Verify the truth table of a D flip-flop (7474)
10. Operate the counters 7490, 7493.
11. Design of 4 bit shift register(shift right).
12. Design of modulo-4 counter using J K flip flop.

Subject Code : IEP-515
Title of the course : Industrial Instrumentation-I Lab

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: Verify the characteristics of RTD, thermocouple, thermistor and thermometer.
CO2: Perform study of vacuum pressure gauge, its calibration and rotameter, .
CO3: Study characteristics of mercury and water column Manometer along with its calibration.
CO4: Study the operation of orifice plate, C-type bourdon tube
CO6: Test the principle of water level and flow measurement, operation of flowmeter.

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

To understand the practicability of **Industrial Instrumentation**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To Study and verify the Characteristics of RTD.
2. To Study and verify the Characteristics of Thermocouple.
3. To Study and verify the Characteristics of an n.t.c Thermistor.
4. To Study and verify the Characteristics of Infrared thermometer.
5. To Study and verify the Characteristics of optical pyrometer.
6. To Study and verify the Characteristics of digital thermometer.
7. To calibrate pressure gauge using Dead Weight Tester.
8. To Study and verify characteristics of the Rotameter.
9. Perform Study of vacuum pressure gauge.
10. Pressure Sensor calibration using mercury Column Monometer.
11. Pressure Sensor calibration using water Column Monometer.
12. Study of Water Level measurement using capacitive principal
13. To Study and verify the working of orifice meter.
14. Study characteristics of flow measurement using differential pressure measurement.
15. Study characteristics of C-Type bourdon tube.
16. Study characteristics of positive displacement flowmeter.

Subject Code : IET-521
Title of the course : Signals and Systems

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

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

CO 1: Interpret signals, convolution and learn various properties.
CO 2: Understand noise, interference and their reduction methods.
CO 3: Be conversant in Fourier Series, Fourier Transform along with their basic properties
CO 4: Analyze sampling, restructuring, sampling theorem, aliasing, digital signal processing.
CO 5: Study Laplace and Z-transform, their basic properties, region of convergence, inverse Laplace and Z-transform, rational system functions.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Introduction to Signals and Systems, System Properties, Convolution of Signals, Linear Shift Invariant Systems and their Properties, Correlation, effects of noise and interference on the measurement system, noise sources and coupling mechanism , method of reducing effects, reliability , choice and economics of the measurement system.	12
	Inroduction to transforms: Introduction to Transforms, Fourier Series and Fourier Transform, Convergence of Fourier Transform, Properties of Fourier Transform.	12
Unit-2	**Sampling and reconstruction of the signal:** Sampling Theorem, Sampling/Reconstruction of Signals, Realistic Sampling, Aliasing, Introduction to Digital Signal Processing, Advantages and disadvantages of digital signal processing over analog signal processing	12
	Laplace and Z-transforms: Introduction to Laplace Transform and Z-Transform, Region of Convergence, Properties of Laplace and Z Transform, Inverse Laplace and Z Transforms, Rational System Functions.	12

Recommended Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, *Signals and Systems*, Pearson Education,2007.
2. Edward W Kamen& Bonnie's Heck, *Fundamentals of Signals and Systems*, Pearson Education, 2007.

Subject Code : IET-522
Title of the course : Electrical and Electronic Measurements

L	T	P	Credits	Weekly Load
4	1	0	4.5	5

Course Outcomes:

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

CO1: Acquire knowledge of the characteristics of measuring instruments and their classification.
CO2: Be conversant in construction, working of measuring instruments and their proficient use.
CO3: Acquire knowledge various methods of electrical parameters measurement.
CO4: Be competent to handle various instruments for the measurement of electrical quantities.
CO5: Demonstrate Cathode Ray Oscilloscope (CRO) and Signal generator and analyzer.

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

Theory

Unit	Main Topics and Course Outlines	Hour(s)
unit-1	**Analog instruments :** Analog instruments, classification of analog instruments, Principles of operation, operating forces, constructional details of PMMC(Permanent magnet moving coil), moving iron, electrodynamometer and electrostatic types of instruments, ohmmeters-series and shunt type, rectifier type instruments, Advantages , disadvantages and their comparison , Extension of Instrument Range	06
	Measurement of power and energy: Power in ac and dc circuits, electrodynamometer wattmeter, measurement of power in single and three phase circuits, Power factor Measurement, Energy meter for ac circuits, single phase induction type watt hour meter, poly phase energy meters.	06
	Instrument transformer: Introduction, current and potential transformer, relationships, characteristics, constructional details, reduction of errors and their comparison, AC and DC current Probes	06
	Bridges and potentiometer: Wheatstone bridge, measurements of resistance ,General form of ac bridge, Measurement of self-inductance , capacitance , mutual inductance and frequency , sources of error and their minimization ,Potentiometer(AC and DC)	06
unit-2	**Electronic measurements:** Introduction, Electronic voltmeter, VIVM(vaccum tube voltmeter) Transistor voltmeter, , BJT,(bipolar junction transistor) FET(field effect transistor) and MOSFET(metal-oxide semiconductor FET) voltmeters, electronic multi-meters, vector voltmeter, vector impedence meter, Current measurements using electronic instruments.LCR meter.	06
	Cathode ray oscilloscope: Introduction, CRO block diagram, CRT(cathode ray tube) circuits, and observation of waveform on CRO, Measurement of voltage, current, phase and frequency.	06

	Instruments for generation and analysis of waveforms: Signal generators, function generator, wave analyzer, harmonic distortion analyzer, spectrum analyzer, spectrum analysis, Q-Meter	06
	Frequency and time interval measurement: Frequency measurement, period measurement, errors in measurement, universal counters and extension of the range of counters, Synchoscope	06

Recommended Books-

1. A.K. Sawhney and PuneetSawhney,*A course on electrical and electronic measurements and instrumentation*, DhanpatRai, 2012.
2. David A Bell, *Electronic Instrumentation and measurement*, 3rd edition, Oxford University Press, 2013.
3. J.B Gupta, *A Course inElectronic and Electrical Measurements & Instrumentation*, S K Kataria and Sons, 1996

Subject Code : IET-523
Title of the course : Control Engineering

L	T	P	Credits	Weekly Load
4	1	0	4.5	5

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire the basic knowledge of control engineering and its scope.
CO2: Analyze the mathematical model of a system and determine the response of different order systems for standard input inputs
CO3: Solve the steady state and transient analysis of a system for standard input inputs
CO4: Analyze the stability analysis of a system.
CO5: Be competent to analyze closed loop control design problems
CO6: Design compensating networks.

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

Theory:

Unit	Main Topics and Course Outline	Hour(s)
Unit-1	**Introductory concept:** Plant, Systems, Servomechanism, Regulating Systems, Disturbances, Open loop control system, Closed loop control system, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems, Concept of feedback, Block diagrams	06
	Modelling: Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic system, electrical mechanical analogies, Use of Laplace transforms, Transfer function, concept of state variable modelling, Block diagram representation, Block diagram simplification for linear systems, signal flow graphs, Mason gain rules.	08
	Time domain analysis: Typical test-input signals, transient and steady state response of the first order systems, second order systems and higher order systems, Transient response analysis with MATLAB, Steady state error and coefficients, pole zero location and stability, Routh-Hurwitz Criterion	08
	Root locus analysis: Introduction, Root-Locus Plots, General Rules for Constructing Root Loci, Root-Locus Plots with MATLAB, Positive Feedback Systems, Conditionally Stable Systems, Root Loci for Systems with Transport Lag	06

Unit 2	**Frequency domain analysis:** Introduction, Bode Diagrams, Plotting Bode Diagrams with MATLAB, Polar Plots, Drawing Nyquist Plots with MATLAB, Log-Magnitude-versus-Phase Plots, Nyquist Stability Criterion, Stability Analysis, Relative Stability, Closed-Loop Frequency Response of Unity-Feedback Systems	08
	Compensation: Necessity of compensation, series and parallel compensation, compensating networks, application of lag and lead compensation	06
	Control components: Proportionate, derivative and integral control, feedback control,Error detectors-Potentiometers and Synchros, AC and DC servomotors, Tachogenerators	06

Recommended Books-

1. Benjamin C. Kuo, *Automatic Control System*, 8th edition, John Wiley & Sons, 2002.
2. Distefano JJ, Stuberud AR and Williams IJ, *Schaum's Outlines of Theory and problems of Feedback and control Systems*, 2nd ed., Tata McGraw Hill,2007.
3. I. J. Nagrath and M. Gopal, *Control System Engineering*, New Age, 2009.
4. K. Ogata, *Modern Control Engineering*, 5th edition, Prentice Hall (PHI), 2010.
5. Richard C. Dorf and Robert H. Bishop, *Modern Control System*, 12th edition, Addison –Wesley, Pearson, New Delhi, 2011.

Subject Code : IET-524
Title of the course : Industrial Instrumentation-II

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire the knowledge of purpose and scope of instrumentation in Industrial processes.
CO2: Be competent to handle of different types Metrology measuring instruments
CO3: Be conversant in construction and working of various instruments for the measurement of force, torque and power.
CO4: Be conversant in construction and working various instruments for the measurement of acoustic and vibration used for industrial purposes.
CO5: Understand the calibration of various industrial instruments.

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

Theory:

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**Metrology:** Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification, - Tool Makers Microscope - interferometery, optical flats, Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: -Sine bar, Sine center, bevel protractor and angleDecker.	08
	Motion and dimensional measurement: Potentiometers, differential transformers, variable inductance & variable reluctance pickups, capacitance pickup, Piezo-electric transducers, digital displacement transducers, Relative velocity Translational and rotational,calibration, velocity by electrical differentiation of displacement voltage signals, average velocity from measure Δx and Δt, mechanical fly ball angular velocity sensor, mechanical revolution counters, tachometer encoder methods, stroboscopic method, translational velocity transducer, eddy current Drag-cup tachometer, Gyroscopic angular displacement and velocity sensors.	10
	Force, torque, and shaft power : Basic methods of force measurement; characteristics of elastic force transducer-Bonded strain gauge, differential transformer, Piezo electric transducer, variable reluctance/FM-oscillator, digital systems. Loading effects; Torque measurement on rotating shafts, shaft power measurement, (dynamometers).	10

Unit-2	**Acoustic and vibrations:** Acoustic, Condenser Microphones, sound pressure level measurement, sound intensity measurement, Vibration **:**Seismic transducers, Types of accelerometers, Potentiometer type, LVDT type, Piezoelectric type accelerometers	08
	Miscellaneous measurement: Viscosity Measurement: Bubble Time, Capillary, Efflux Cup Falling-Ball, Oscillating-Piston, ultrasonic viscometers; pH Measurement: electrochemical and optical method for pH measurement, Density Measurement: buyoncy type, balance type, column type, absorption type, radioactive densitometers, Humidity and Moisture measurement: definitions – absolute, specific, relative humidity and dew point, Dry and wet bulb psychrometer, Hair hygrometer, dew point meter, infrared hygrometer (conductance and capacitance method). Specific gravity Measurement Conductivity Measurement	12

Recommended Books:

1. Andrew and Williams, *Applied instrumentation in process industries*, Vol.- 1/2/3, Gulf professional.
2. Austin E. Fribance, *Industrial instrumentation fundamentals*, McGraw hill, 1984.
3. B. G. Liptak, *Instrument Engineers Handbook*, Vol- 1, CRC Press, 2003.
4. D. Patranabis, *Principles of industrial instrumentation*, 2nd edition,TMH, 2005
5. E. B. Jones, *Instrument technology*, 3rd edition, Newnes-Butterworths, 1974.
6. Ernest O. Doebelin, *Measurement Systems: Application and Design*, 5th edition, McGraw-Hill Higher Edu., 2003.
7. Fairgeyer&Okun, *Water and Waste Water Technology*, 3rd edition, John Wiley and Sons, 2010.
8. R. K. Jain, *Mechanical and Industrial Measurements,* 12th edition, Khanna Publishers, 2013.

Subject Code : IEP-522
Title of the course : Electrical and Electronic Measurements Lab

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: Acquire knowledge of the characteristics of measuring instruments and their classification.
CO2: Be conversant in construction, working of measuring instruments and their proficient use.
CO3: Acquire knowledge various methods of electrical parameters measurement.
CO4: Be competent to handle various instruments for the measurement of electrical quantities.
CO5: Demonstrate Cathode Ray Oscilloscope (CRO) and Signal generator and analyzer.

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

To understand the practicability of **Electrical and Electronic Measurements**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Study of principle of operation of various types of electromechanical measuring instruments.
2. a) To measure high value of DC current by a Low Range DC Ammeter and Shunt.
   b) To measure high value of DC voltage by a Low Range DC Voltmeter and Multiplier
3. a) To measure high value of AC Current by a Low Range AC Ammeter and Current Transformer.
   b) To measure high value of AC Voltage by Low Range Voltmeter and Potential Transformer
   Measurement of resistance using Wheatstone Bridge.
4. To measure active and reactive power in 3 phase balanced load by one wattmeter method.
5. To measure the active power in three phase balanced and unbalanced load by two wattmeter method and observe the effect of power factor variation on wattmeter reading.
6. To calibrate and use the Induction Energy Meter.
7. Measurement of resistance using Kelvin's Bridge.
8. Measurement of self inductance using Anderson's Bridge.
9. Measurement of capacitance using Schering Bridge.
10. Plotting of Hysteresis loop for a magnetic material using flux meter.
11. Measurement of frequency using Wein's Bridge.
12. To study the connections and use of Current and potential transformers and to find out ratio error.
13. Determination of frequency and phase angle using CRO.
14. Measurement of unknown voltage using potentiometer.
15. To find 'Q' of an inductance coil and verify its value using Q- meter.
16. Calibration of ac voltmeter and ac ammeter.
17. Measurement of form factor of a rectified sine wave and determine source of error if r.m.s.value is measured by a multi-meter.

Subject Code : IEP-523
Title of the course : Control Engineering Lab

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: Acquire the basic knowledge of control engineering and its scope.
CO2: Analyze the mathematical model of a system and determine the response of different order systems for standard input inputs
CO3: Solve the steady state and transient analysis of a system for standard input inputs
CO4: Analyze the stability analysis of a system.
CO5: Be competent to analyze closed loop control design problems
CO6: Design compensating networks.

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

To understand the practicability of **Control Engineering**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
2. To analyze P, PI and PID temperature controller for an oven and compare their performance.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To design Lag, Lead and Lag-Lead compensators using Bode plot.
5. To study DC position control system
6. To test synchro-transmitter and receiver and obtain output V/S input characteristics
7. To determine speed-torque characteristics of an ac servomotor.
8. To analyze performance of servo voltage stabilizer at various loads using load bank.
9. To study behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.
10. To test PID Controller for simulation proves like transportation lag.

Software based experiments (Use MATLAB, LABVIEW software etc.)

11. To determine time domain response of a second order system for step input and obtain performance parameters.
12. To convert transfer function of a system into state space form and vice-versa.
13. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfer functions and examine the stability of the closed loop system.

Subject Code : IEP-524
Title of the course : Industrial Instrumentation-II Lab

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: Test the operation of viscometer, densitometer and accelerometer.
CO2: Verify the characteristics of hygrometer, LVDT and strain gauge.
CO3: To study the operation of hall effect sensor, LDR, pH meter and Stroboscope.
CO4: To analyse the characteristics of conductivity meter, Tachometer, digital RPM counter and Hydrometer
CO5: Verify the characteristics of Piezoelectric Transducer, Moving coil loudspeaker and buzzer.

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

To understand the practicability of **Industrial Instrumentation**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Measurement of Viscosity using viscometer.
2. Measurement of density using densitometer.
3. To Study Characteristics of accelerometer.
4. Measurement of humidity using rotational hygrometer.
5. To Study Characteristics of inductive transducer LVDT.
6. To Study Characteristics of strain gauge for load measurement.
7. To Study Characteristics of hall effect sensor.
8. To Study Characteristics of LDR applied sensor.
9. Study of characteristic of Stroboscope along with its application in speed measurement.
10. Study of pH meter.
11. To Study Characteristics of conductivity meter.
12. To Study Characteristics of Speed measurement- Tachometer.
13. To Study Characteristics of digital RPM counter.
14. To measure the torque with the help of Digital Instrumentation Tutor.
15. To determine the specific gravity of battery acid with the help of Hydrometer.
16. To Study the Characteristics of Piezoelectric Transducer.
17. To Study the Characteristics of Moving coil loudspeaker.
18. To Study the Characteristics of Buzzer.

Subject Code : IET-611
Title of the course : Microprocessor and Applications

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Learn history, architecture of 8, 16, 32 & 64 bit Microprocessor.

CO 2: Understand 8085 microprocessor, its architecture and programming.

CO 3: Be conversant in 8086 microprocessor, its architecture and program development tools.

CO 4: Develop the programming of 8086 microprocessor with conditional jump, timing and delay loops.

CO 5: Study connections & interfacing of 8086, 8259 interrupt controller, 8254 timer/counter, A/D and D/A converter.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction to microprocessors:** Types of computers, Microprocessor Evolution and types, CPU operation and terminology, idea of 8- bit, 16-bit, 32-bit and 64- bit Microprocessors from Intel, Motorola and Zilog and their comparisons.	08
	Introduction to 8-bit microprocessor: 8085 Microprocessor architecture, Instruction format, Addressing Techniques, classification of instructions, and overview of the 8085 instruction set. Simple programs.	08
	Introduction to 16-bit microprocessor: 8086 Internal Architecture, Instruction Format, Addressing modes, program development steps, and 8086 instruction set, Assembler directives, Assembly language, program development tools.	08
Unit-2	**Programming of 8086:** Simple sequence programs, jumps, flags, conditional Jumps, IF THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros.	08
	8086 system connections, timing, troubleshooting: Pin-diagram, max/min. modes, timing diagrams, use of logic analyzer to observe Bus Signals, troubleshooting a simple 8086 based system**,** 8086 Interrupts, responses & applications.	08
	Interfacing of 8086: Memory Interfacing, Programmable parallel ports & handshake, 8254 software- programmable timer/counter, 8259 A priorities Interrupt Controller, Interfacing a Microprocessor to Keyboards and alphanumeric displays, D/A converter operation, interfacing and applications, *A/D* converter specifications	08

Recommended Books

1 B.Ram.,*Fundamentals of Microprocessors and Microcomputers*. Dhanpat Rai & Sons, 1998.

2 Brey, Barry B.Bray., *The INTEL Microprocessors 8086/88, 80186, 286, 386, 486, Pentium Pro Processors, Architecture, Programming and Interfacing*., Prentice Hall (India).

3 Douglas V. Hall,. *Microprocessors and interfacing: Programming and Hardware.*, Tata McGraw Hill, 2007.

4 Gaonkar and Ramesh S., *Microprocessor Architecture, Programming and Applications with the 8085.*, Penram International.

5 Ray A.K. and Bhurchandi K.M., *Advanced Microprocessors and Peripherals*, Tata McGraw Hill.

Subject Code : IET-612
Title of the Course : Analytical and Optical 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: Differentiate between analytical and other measuring instruments.
CO 2: Apply the principle of spectrometry and chromatography in industrial application
CO 3: Learn the concept of electron microscopy, SEM and TEM and their applications.
CO 4: Demonstrate the application of Potentiometry and gas analyzer
CO 5: Understand the data presentation and statistic analysis of analyticalinstruments .

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Difference between analytical and other instruments, sampling, sampling system for liquids and gases, sampling components, automatic and faithful sampling.	06
	Spectrometry : Electromagnetic Radiation, Radiation Sources, Optical Sources and Detectors, Beer's Lamberts Law, UV ,IR and Visible Spectrophotometer, Flame Photometer and Atomic Absorption Spectrometer : Basic principle , block diagram and related instrumentation Basic principle, block diagram and related instrumentation of X-ray analyzers, NMR spectrometry, Mass spectrometry and its types.	06
	Chromatography: Basic Principle and Types of Chromatography: Types, Block Diagram and related instrumentation of gas and Liquid Chromatography.	06
Unit-2	**Electron microscopy:** Introduction, types of electron microscopy: Scanning electron microscope (SEM) and transmission electron microscopy (TEM), Difference between optical microscopy, SEM and TEM	06
	Gas analyzer: Types: paramagnetic oxygen analyzer, IR gas analyzer, thermal conductive gas analyzer, analyzer based on gas density	06
	Potentiometry: Electro chemical cell, Ion sensitive Electrodes, Solid state sensors, gas sensing electrode, bio catalytic membrane electrode.	06
	Data presentation and analysis: Analytical data presentation , error analysis	06

Recommended Books:
1. R. SKhandpur,*Handbook of Analytical Instruments*, McGraw-Hill Education , 2015.

2. R P Khare, *Analysis Instrumentation: An Introduction.*, CBS Publisher, 2008.
3. Patranabis, *Principles of Industrial Instrumentation*, Tata McGraw-Hill Education, 2001.
4. Willard, H.H., L.L. Jr. Merritt, J.A. Dean, and F.A. Jr. Settle, *Instrumental methods of analysis.*Wads Worth , 1988.

Subject Code : IET-613
Title of the course : Non-Linear and Discrete Control System

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

CO 1: Construct state space models from transfer function models.
CO 2: Solve linear time-invariant and time varying control system.
CO 3: Access the controllability and observability of a control system.
CO 4: Recognize features of nonlinear system and analysis of non-linear systems using describing function and phase plane method.
CO 5: To characterize the Lyapunov stability properties of state space systems.
CO 6: Study of discrete control system and its analysis.

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

Theory:

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**State space analysis & design:** Review of state space representation for linear continuous time system, solution of linear time invariant state equations, controllability and observability, solution of state equation for discrete system, state space analysis of discrete time systems, pole placement techniques.	08
	Non-linear control systems; Introduction to non-linear feedback control system, different types of non linearities, special features of non-linear systems: limit cycles, jump resonance and sub harmonics resonance etc. Definition of describing function.(D.F.), D.F.'s for various non-linearities, D.F. analysis of non-linear control systems, stability analysis using Limit cycles, and jump resonance.	10
	Phase plane analysis: Phase-plane analysis for non linear systems. Singular points, Construction of phase-plane plots for non -linear systems.	08
Unit-2	**Liapunov's stability analysis:** Introduction, Concept of local, global and asymptotic stability, Liapunov's Stability criterion, The direct method of Liapunov and the linear systems, Methods of constructing Liapunov function for non-linear system.	12
	Discrete time control systems (Part-I): Basic elements of a discrete data control system & its advantages over the continuous time systems A/D and D/A conversions, Spectrum analysis of sampling process and signal reconstruction Sample and hold device, Z-transforms, Inverse Z- Transform, Pulse transfer function, Pulse transfer functions of cascaded elements, Pulse transfer function of close loop system, Impulse and Frequency Response of Discrete Time System	12
	Discrete time control systems (Part-II): Modified Z-transform, Stability analysis of close loop systems in Z-domain, Stability criterion by Jury's test, schur-cohn	10

	method, Stability analysis by bilinear transformation and Routh's stability criterion, state space representation of discrete time systems.	

Recommended Books-

1. Benjamin C. Kuo, *Automatic Control System*, 8th edition, John Wiley & Sons, 2002.
2. I. J. Nagrath and M. Gopal, *Control System Engineering*, New Age, 2009.
3. K. Ogata, *Modern Control Engineering*, 5th edition, Prentice Hall (PHI), 2010.
4. Richard C. Dorf and Robert H. Bishop, *Modern Control System*, 12th edition, Addison –Wesley, Pearson, New Delhi, 2011

Subject Code : IET-614
Title of the course : Process Dynamics and Control

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Analyze and formulate mathematical model of process element.
CO2: Design closed loop system with various types of controllers.
CO3: Demonstrate the working of various control valves and their selection criteria.
CO4: Understand the operation and tuning of Proportional (P), Intergral (I), Derivative (D), and composite mode of controllers,
CO5: Acquire knowledge of feedback, feed forward, ratio, cascade control configurations and multivariable interaction.

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

Theory

Unit	Main Topics and Course Outline	Hour(s)
unit-1	**Introduction to process control:** Introduction, Basic components, diagrammatic representation, symbol and Terminology, process control block diagram, mechanical, Hydraulic and Pneumatic System and their components	06
	Process dynamics and mathematical modeling: Process variables, mathematical modeling of liquid, gas, and thermal, mechanical and chemical systems, Linearizing techniques, Liquid level control in a tank, Dynamics of manometer, response of non-interacting and interacting first-order elements in series, Mixing process, Heat transfer process, Distillation column.	08
	Controller principles: control system parameters – discontinuous controller modes – two position mode – multiposition mode – floating control mode – continuous controller modes – proportional controller mode – integral control mode – derivative control mode – composite controller modes – PI, PD, and three mode controller.	06
unit-2	**Closed loop response and controller tuning:** Single and combined modes in closed loop, static error, velocity error. Dynamic behaviour of feedback control processes for different modes, IAE, ISE, IATE criteria, Tuning of controllers, closed loop method – ultimate method – damped oscillation method – process reaction curve method – open loop tuning – variation on the open loop fit – Ziegler Nichols method – frequency response method – comparing tuning methods – integral criteria in tuning	06
	Controller hardware: Electronic and digital controllers - design considerations and implementation, single and composite modes of controllers, Direct digital control (DDC) - components, benefits, digital controller realization.	06

	Final control: Final control operation – signal conversion (analog and digital electrical signals) –Actuators (electrical, pneumatic and hydraulic) – Control valve classification and types, selection criteria for control valves, function (mechanical, electrical and fluid valves).	06
	Multiple loop control schemes: On-off Controllers, Cascade and Feed forward Controllers, Split Range Controllers, ratio controls, Single loop, multi loop & self-tuning controllers, set point control (SPC)	
	Multi-loop interaction : Introduction, features and examples of MIMO Process, Design of cross controllers, Relative gain array and selection of control loop.	04

Recommended Books-

1. B. G. Liptak, *Process Control: Instrument Engineer,*' Handbook, 3rd edition, Butterworth Heinemann, 1995.
2. B. Wayne Bequette, *Process Control: Modeling, Design and Simulation*, Prentice Hall, 2002.
3. Dale E. Seborg, Duncan A. Mellichamp and Thomas F. Edgar, *Process Dynamics and Control,* 3rd edition, John Wiley & Sons, 2010.
4. F.G. Shinskey, *Process Control Systems: Application, Design and Tuning*, 4th edition, McGraw Hill Higher Education, 1996.
5. George Stephonopolous , Chemical *Process Control : An Introduction To Theory And Practice*,1st edition, PHI, 2008
6. Gregory K. Mcmillan and Douglas M. Considine, *Process/Industrial Instruments and Controls Handbook*, 5th edition, McGraw-Hill Professional, 1999.
7. Krishna Kant, *Computer based Industrial Control*, 2nd edition, PHI, 2010.
8. Peter Harriott, *Process Control*, 1st edition, Mcgraw Hill Education, 2001.
9. SurekhaBhanot, *Process Control: Principles and Applications*, Oxford University Press, 2008.

Subject Code : IET-615
Title of the course : Telemetry and Data Acquisition System

L	T	P	Credits	Weekly Load
3	0	0	3	3

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

CO 1: Analyzevarious data acquisition systems, their components and applications.
CO 2: Learn methods of data transmission, transmission channels and different type of modulation.
CO 3: Describe construction and working principle of digital to analog converters and analog to digital converters.
CO 4: Acquire knowledge of block diagram, classification and working principle of different telemetry system.
CO 5: Understand the construction and working principle of display system and recorders.

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

Theory:

Unit	Main Topics and Course Outline	Hour(s)
Unit-1	**Data Acquisition Systems:** Block diagram of data acquisition System & its applications, Analog& digital acquisition systems, signal conditioning of the inputs, single channel data acquisition, multi-channel DAS, computer based DAS, uses of data acquisition systems, use of recorders in digital systems & block diagram of digital data recording system, data logging system, compact data logger , modem digital data acquisition,digital transducer.	08
	Data Transmission System: Methods of data transmission, transmission channels & media, Modulation & demodulation, amplitude, frequency &phase modulation, Comparison between frequency & amplitude, pulse modulation (PAM, PDM, PFM, POM), delta modulation, adaptive data modulation &Companding, digital data codes, error correcting & error detecting codes, Asynchronous & synchronous data transmission, pulse code formats used in data transmission, radio link, frequency division &time division multiplexing, time division multiplexing using mechanical commutator, electronic time division multiplexing system, block diagram of AM frequency division multiplexing system.	08
	Digital Instruments: Digital to analog converters, analog to digital converters, electromechanical ADC, Digital Transducers.	06
Unit-2	**Introduction to Telemetry Principles:** Definition, generalized block diagram of Telemetry System, Classification of Telemetry system, Working principle, salient features and applications of the following Telemetry System: DC Voltage, current and position telemetry system, Pulse telemetry System, Introduction to Satellite telemetry And Fibre Optic telemetry system	08

	Modems, Transmitters and receivers: Modems Introduction, Transmitters, Transmission Techniques, Inter stage Coupling, Receiver, Introduction to Antennas	08
	Display Systems: Construction, principle of operation and salient features of various kinds of display devices	05
	Recorders: Working principle, Construction, operation and salient features of Strip Chart Recorder, X-Y strip chart recorder and magnetic recorder	05

Recommended Books-

1. AK, Sawhney. *Electrical and Electronic Measurement and Instrumentation*. Dhanpat Rai and Sons, 1993.
2. D, Patranabis. *Telemetry Principles*. Tata McGraw Hill., 1999.
3. EL, Gruenberg. *Handbook of Telemetry & Remote Control*. Tata McGraw Hill., 1967.
   HS, Kalsi. *Electronic Instrumentation*. Tata McGraw Hill, 2010.

Subject Code : IET-616
Title of the course : Environmental Instrumentation

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Understand instrumentation, control and various detectors used for environment.
CO 2: Study Water quality, its parameters, various analysers and their application.
CO 3: Be conversant in Water treatment techniques and instrumentation used.
CO 4: Analyze Waste water monitoring, treatment and latest treatment plants.
CO 5: Study Air pollution, its monitoring and rain water harvesting.

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

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Necessity of instrumentation & control for environment, sensor requirement for environment. Instrumentation methodologies: Ultraviolet analyzers, total hydrocarbon analyzers using flame ionization detector, Gas chromatography in environmental analysis, photo ionization, portable & stationary analytical instruments.	06
	Water quality: Quality of water: Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity, detectors, Opacity monitors, pH analyzers& their application, conductivity analyzers& their application. Water treatment: Requirement of water treatment facilities, process design.	08
	Water treatment techniques: Sedimentation & flotation: General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin , reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation. Ground water monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution	10
Unit-2	**Waste water monitoring:** Waste water monitoring: Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. Air pollution: definitions, energy environment relationship, importance of air pollution, air pollution from thermal power plant, their characteristics & control. Air sampling methods &equipments, analytical methods for	10

	air pollution studies. Control of air pollution.	
	Air monitoring: Air monitoring: measurement of ambient air quality. Flow monitoring: Air flow measurement, gas flow, non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, rate of NGOs municipal corporation, Govt., limitations. Quality assurance of storage water.	12

Recommended Books-

1. M. N. Rao and H. V. N. Rao, *Air pollution engineering*, Tata Mcgraw Hill, 2000.
2. Wark and Warner Davis, *Air Pollution: Its Origin and Control*, Pearson Education , 1997.
3. Weber and Walter J, *Physicochemical processes for water quality control*, Wiley-Interscience, 1972.

Subject Code : IET-617
Title of the course : Robotics

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Learn the fundamentals of Robotics, various actuators and transmission systems.
CO 2: Study various sensors for motion, detection and machine vision techniques.
CO 3: Be conversant in various end effectors, gripping mechanism and arm Kinematics in robots.
CO 4: Manipulate Robot arm dynamics & trajectory using Lagranges Euler, Newton Euler formulations.
CO 5: Analyze case studies including hill climbing techniques and robot selection.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Fundamentals of robot technology:** Robots in science fiction – automation and robotics, Asimov's laws of Robotics Definition of robot, anatomy of a robot, classification (type of control, capability, configuration and mobility), use of robots, robot motions and degrees of freedom, joint notation scheme ,work volume ,speed of motion, load carrying capacity – speed of response and stability, precision of movement.	08
	Actuators & power transmission system: Pneumatic – hydraulic – electric – dc servomotor – stepper motor - ac servomotors. **Power transmission systems:** Gears – power screws – pulleys, chains and harmonic drives – horse power – electric motor efficiency.	08
	Transducer and sensors: Position sensors – potentiometers – resolvers – encoders – velocity sensors – tactile sensors – touch sensors (capacitance, resistance, resistive material, etc.) – force sensors (force sensing resistor, capacitance, force sensing wrist, joint sensing, and tactile array sensors) – proximity sensors – optical proximity sensors/range sensors (two emitter proximity sensor, ranging light based sensor, LIDAR, etc.) – Acoustic sensors – Magnetic sensors.	08
	Machine vision: Introduction – the sensing and digitalizing function in machine vision – imaging devices – lighting techniques – ADC – image processing and analysis – image data reduction – segmentation feature extraction – object recognition – training the vision system – robotic applications.	08
Unit-2	**Robot end effectors:** type of end effectors – mechanical grippers – basic definitions and operations – type of gripper mechanism – other types of grippers (vacuum cups, magnetic grippers, adhesive grippers, and hooks and scoops) – tools – the robot to	08

	end effector interface – checklist of factors in the selection and design of grippers.	
	Robot arm kinematics: Construction of manipulator – the direct kinematics problem - the inverse kinematics problem – inverse transform techniques for Euler Angles solution – geometrical approach.	
	Robot arm dynamics & planning of manipulator trajectories: Lagrange euler formulation – kinetic energy of a robot manipulator – potential energy of robot manipulator – motion equations of a manipulator – Newton euler formulation – rotating coordinate system – moving coordinate system. Joint interpolated trajectory – planning of Cartesian path trajectories – four types of robot controls.	08
	Case studies: Hill climbing techniques – multiple robots – machine interface – robot cell design –selection of robot.	06

Recommended Books-

1. Kaplan and Irvin, *Nuclear Physics*, Narosa, 1987.
2. G. F. Knoll, *Radiation, Detection & Measurement*, John Wiley & Sons, 1998.
3. P.W.Nicholson, *Nuclear Electronics,* John Wiley, 1998.
4. S. S. Kapoor and V. S. Ramamurthy, *Nuclear Radiation Detectors,* Wiley Eastern Limited, 1986.

Subject Code : IET-618
Title of the course : Building Automation

L	T	P	Credits	Weekly Load
4	0	0	4	4

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

CO1: Acquire the knowledge of dynamic performance of building processes/systems, control fundamentals and building process control strategies for better energy efficiency and building environmental performance
CO2: Design and analyze fire alarm system (FAS) and various Security systems
CO3: Design and analysis of heating, ventilating and air conditioned (HVAC) system,
CO4: Implement control for building management.
CO5: Acquire the knowledge of energy management and calculate project life cycle.

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

Theory

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**Fire Alarm System (FAS):** Fundamentals: What is Fire? Fire modes, History, Components, and Principles of Operation FAS Components: Field Components, Panel Components, Applications. FAS Architectures: Types of Architectures, Examples FAS loops: Classification of loops, Examples. Power Supply design for FAS. Cause & effect matrix: Examples Fire Standards: FAS Design procedure in brief, National Fire Protection Association (NFPA) 72A, BS 5839, IS	08
	Security Systems: Fundamentals: Introduction to Security Systems, Concepts, Access Control System: Access Components, Access control system Design., Closed-circuit television (CCTV) Camera: Operation & types, Camera Selection Criteria, Camera Applications, digital video recorder (DVR), Digital video Manager (DVM), Network design, Storage design, CCTV Applications: CCTV Applications Perimeter Intrusion: Concept, Components, Technology, Advanced Applications Security Design: Security system design for verticals	08
	Introduction to Heading, Ventilating and Air Conditioned (HVAC) System: Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating, Cooling etc.) Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms, Examples. Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heat loss Processes: Heating Process & Applications (i.e. Boiler, Heater), Cooling Process & Applications (i.e. Chiller), Ventilation Process & Applications (i.e. Central Fan System, air handling unit (AHU), Exhaust Fans, Unitary Systems (variable air Volume (VAV), Fan Coil Unit (FCU) etc.	08

Unit-2	**Control Theory:** Control Theory: Instrumentation Basics, Field components & use, direct digital control (DDC) & applications Architecture: Honeywell Architecture, BMS Components Control Panel: HVAC Control Panel, motor control centre (MCC) Basics, Panel Components Communication: Communication Basics, Networks, Building automation and control network (BACnet), Modbus, local operating network (LON)	08
	Energy Management: ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Symbols Energy Management: Advantages of building management (BMS), Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (leadership in Energy and Environmental design (LEED), Concept & Examples	08
	Applications: Project Life Cycle: Integrated BMS (IBMS) (HVAC, Fire & Security) project cycle, Project steps BMS Verticals: Applications of BMS, Examples Integration: IBMS Architecture, Normal & Emergency operation	08

Recommended Books-

1. Chartered Institution of Building Services Engineers, *Building Control Systems, Applications Guide*, Butterworth-Heinemann Ltd, 2000.
2. In Partnership with NJATC, *Building Automation: Control Devices and Applications*, Amer Technical Pub, 2008.
3. John E. Traister, *Security/Fire Alarm Systems: Design, Installation, and Maintenance*, 2nd sub edition, Mcgraw-Hil, 1995.
4. John I. Levenhagen, *HVAC Control System Design Diagrams*, New edition, McGraw-Hill Professional, 1998.
5. John J. McGowan, *Building Automation Online*, Fairmont Press, 2004.
6. Michael F. Hordeski, *HVAC Control in the New Millennium*, Prentice Hall, 2001.
7. Robert M Gagnon, *Design of Special Hazards and Fire Alarm Systems*, 2nd edition, Thomson Delmar Learning, 2007.
8. Reinhold A. Carlson, Robert A. Di Giandomenico, *Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs)*, R.S. Means Company, 1991.

Subject Code : IET-619
Title of the course : Data Communication and Networking

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Analyze data communication networks, internet protocols, standards, layered tasks & addressing.
CO 2: Understand the basics of analog and digital signals along with their properties.
CO 3: Implement A/D and D/A converters, error detection, correction and data link techniques.
CO 4: Develop basics of network layer, addressing, internet working and address mapping.
CO 5: Be conversant with data transport, domain name system, remote logging, mile transfer, www and http.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction and network models:** An Introduction to data communication and networks, internet, Protocols and standards, layered tasks, Open System Interconnection (OSI) model, Layers in OSI model, Transmission Control Protocol / Internet Protocol (TCP/IP protocol) suite, Addressing.	08
	Physical layer and media: Introduction, Analog and digital signals, periodic and non periodic signals, Digital to digital conversion, analog to digital conversion, transmission modes , digital to analog conversion, analog to analog conversion.	08
	Data link layer: Error detection and correction, data link control, multiple access, Ethernet, wireless LAN-IEEE 802.11, Bluetooth	08
Unit-2	**Network layer:** Need for the network layer, IPv4 and IPv6 addresses, Internet working, address mapping	08
	Transport Layer: Process to process delivery, User Datagram Protocol (UDP), TCP and Stream Control Transmission Protocol (SCTP)	08
	Application layer: Domain name system, remote logging , electronic mail and file transfer, www and http	08

Recommended Books-

1. Comer, Douglas E. *Computer Networks and Internets.* Pearson Education Asia, 2001.

2. Dcou Reynders, Steve Mackay, Edwin Wright. *Practical Industrial Data Communications.* 1st edition Elsevier, 2005.
3. Forouzan, Behrouz A. *Data Communications and Networking.* Tata McGraw Hill Publishing Company, 2000.
4. Miklovic, Daniel T. *Real time control network.* ISA , 1993.
5. Tanenbaum, Andrew S. *Computer Networks.* Pearson Education, 2002.

Subject Code : IEP-611
Title of the course : Microprocessor and Applications Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO 1: Create program for addition, subtraction of numbers in decimal, hexadecimal and BCD system.

CO 2: Write program to perform multiplication, division of 8 bit numbers, obtain largest , smallest number from an array and arrange data in ascending, descending order.

CO 3: Write a program to convert hexadecimal number into ASCII number and vice versa..

CO 4: Develop a program to initiate and check transmission, reception of 8251, interfacing of 8253 timer and verify operation of 8253 in six modes.

CO 5: Create interfacing of DAC with 8085 for generation of square, sawtooth and triangular waves, implement serial communication through RS-232 C port.

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

To understand the practicability of **Microprocessor and Applications**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8 bit numbers using 8085.
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program to arrange an array of data in ascending and descending order.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
9. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085 through RS-232 C port.

Subject Code : IEP-612
Title of the Course : Analytical Instrumentation Lab

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: To analyze operation of flame photometer and viscometer.
CO 3: Apply the principle of UV spectrometer for transmittance, absorbance and concentration.
CO 4: Apply the principle of Visible spectrometer for transmittance, absorbance and concentration.
CO 2: To analyze operation of Conductivity meter and gas chromatograph.
CO 5: Analyze operation of Atomic Absorption Spectrometer for transmittance, absorption and concentration of copper sample .

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

To understand the practicability of **Analytical Instrumentation**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To estimate the concentration of given sample in a solution (PPM) in on flame photometer.
2. To measure the viscosity of given solution using viscometer.
3. To measure the transmittance of a given sample solution using UV spectrometer.
4. To measure the transmittance of a given sample solution using Visible spectrometer.
5. To measure the conductivity of given sample solution using Conductivity meter.
6. To measure the absorbance of a given sample solution using UV spectrometer.
7. To measure the concentration of a given sample solution using UV spectrometer.
8. To measure the concentration of a given sample solution using Visible spectrometer.
9. To measure the absorbance of a given sample solution using Visible spectrometer.
10. To determine the composition of a given sample using gas chromatograph.
11. To determine the transmittance of the copper sample using Atomic Absorption Spectrometer.
12. To determine the absorption of the copper sample using Atomic Absorption Spectrometer.
13. To determine the concentratrion of the copper sample using Atomic Absorption Spectrometer.

Subject Code : IEP-614
Title of the course : Process Dynamics and Control Lab

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: Analyze characteristics of ratio, cascade and feed forward control
CO2: Design proportional (P), proportional plus integral (PI),. proportional plus derivative (PD) and proportional plus integral plus derivative (PID) controller
CO3: Demonstrate the working of feedback control and I/P converter.
CO4: Analyze operation of feedback temperature and feedback pressure control system
CO5: To perform tuning of P, PI, PID controller and analyze pressure transmitter.

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

To understand the practicability of **Process Dynamics and Control**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Characteristics of ratio control.
2. Characteristics of cascade control.
3. Characteristics of feed-forward control.
4. Design of proportional controller.
5. Design of proportional plus integral controller.
6. Design of proportional plus derivative controller.
7. Design of proportional plus integral plus derivative controller
8. Characteristics of feed-back control.
9. Study of I/P Converter output to control valve displacement.
10. Study of feedback pressure control plant with DCS panel.
11. Study of feedback temperature control system.
12. Tuning of P controller.
13. Tuning of PI controller.
14. Tuning of PID controller.
15. Study of pressure transmitter.

Subject Code : IET-621
Title of the course : Microcontroller and Embedded System

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Study 8051 microcontroller along with its the internal architecture.
CO 2: Develop knowledge of programming of 8051 microcontroller using assembly language.
CO 3: Analyze 8051 microcontroller design, memory mapping and serial data transmission.
CO 4: Be conversant in application of 8051 microcontroller.
CO 5: Implement PLDs and FPGA with knowledge of their architecture and design.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Microprocessor, Micro-controllers and their comparison. The 8051 Architecture: Introduction, 8051 micro-controller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts	12
	8051 Assembly Language Programming: Instruction format and addressing techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions), The mechanics of programming, assembly language programming process, programming tools and techniques,	12
Unit-2	**8051 Microcontroller Design:** Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding Input/Output (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
	Microcontroller Applications: Interfacing keyboards, displays, Digital to Analog (D/A) and Analog to Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems: Introduction to Programmable Logic Devices (PLDs) and Field Programmable Gate Array (FPGA) - architecture, technology and design issues, implementation of 8051 core.	12

Recommended Books-

1. Ayala, Kenneth J. *The 8051 Micro Controller- Architecture, Programming and Application*, .Penram International Publication .
2. Bhanot, Surekha, Oxford Higher Education, 2008.
3. Gary, Dunning. *Introduction to PLCs*. Tata McGraw Hill, 2005.

4. Mazidi M. A., Mazidi J. G. The 8051 Micro-controller & Embedded System. Pearson Education, 2008.
5. Peatman, John B. Design with Micro Controller. Tata McGraw Hill, 1988.

Subject Code : IET-622
Title of the course : Computer Control of Processes

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Acquire knowledge of computer control system.
CO 2: Understand Programmable logic controller including its characteristic and classification.
CO 3: Know about distributed control system and its configuration.
CO 4: Analyze SCADA system, its hardware and software interfacing and applications.

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

Theory:

Unit	Main Topics and Course Outline	Hour(s)
Unit-1	**Introduction:** Hierarchical computer control system – data acquisition system – stand alone data acquisition – PC based data acquisition – analog signal conditioning – analog isolation – surge protection – digital signal conditioning – digital isolation – analog multiplexer – data loggers – supervisory control – computer based controllers-direct digital control (DDC) – SMART transducers and transmitters – SMART pressure transmitter – SMART temperature transmitter – SMART control valve – capabilities of SMART transducer.	12
	Programmable Logic Controller (PLC): PLC versus relay – characteristic functions of a PLC – PLC versus PC – PLC block diagram –input (I)/ output (O) configuration – direct I/O – Parallel I/O – Serial I/O – slice I/O – input andoutput module (discrete and analog) – input and output devices – RS 232, 488 and 485 – CPU – memory unit – input image file – output image file – power supply – program loaders – hand held and computer based loaders – types of PLC software – programming languages – ladder programming – file organizing and addressing – instruction set – timers and counters instructions – communication instructions – I/O andInterrupt instructions – math instruction – logical instruction – complete scan cycle – program execution – different types of PLC – system installation recommendations.	12
Unit-2	**Distributed control systems (DCS):**PLC versus DCS – DCS configuration – control room forDCS – the control console equipment – displays – software configurations – relay rack mounted equipment – local control units – communication between components – data highway design – highway compatibility – data highway communications – network access methods.	12
	Introduction to Supervisory Control and Data Acquisition (SCADA) system: Definition of SCADA – elements of SCADA system block diagram, – communication in SCADA – SCADA hardware and Software, applications –	12

Recommended Books:

1. B. G. Liptak, *Process Control: Instrument Engineers' Handbook*, 3rd edition, Butterworth Heinemann, 1995.
2. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, *Process Dynamics and Control*, 3rd edition, John Wiley & Sons, 2010.
3. Gregory K. Mcmillan, Douglas M. Considine, *Process/Industrial Instruments and Controls Handbook*, 5th edition, McGraw-Hill Professional, 1999.
4. Krishna Kant, *Computer based Industrial Control*, 2nd edition, PHI, 2010.
5. Peter Harriott, *Process Control*, 1st edition, McGraw Hill Education, 2001.
6. Surekha Bhanot, *Process Control: Principles and Applications*, Oxford University Press, 2008.
7. S.K. Singh, *Industrial Instrumentation and Contriol*,, Tata McGraw Hill, 2nd Edition, 2003
8. Curtis Johnson, *Process control instrumentation technology*, Prentice Hall, 1998
9. M. Chidambaram, *Computer Control of Processes*, Narosa Publication, 2002

Subject Code : IEO-62*
Title of the course : Industrial 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: Acquire the knowledge of purpose and scope of instrumentation in Industrial processes.

CO2: Be competent to handle of different types of temperature measuring instruments likeThermistor, Thermocouple etc. and their application in various Industrial processes.

CO3: Be conversant in construction and working various pressure measuring instruments.

CO4: Be conversant in construction and working various flow and level measurement devices used for industrial purposes.

CO6: Understand the calibration of various industrial instruments.

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

Theory:

Unit	Main Topics and Course Outline	Hour(s)
Unit-1	**Temperature measurement:** Temperature scale and conversion, principle of vapor, gas, liquid filled thermo meters, bimetallic thermo meter, pressure spring thermometer, thermocouple and its configuration, extension wires, resistance temperature detector & compensation techniques, Thermistor, Pyrometry- Stefan Boltzmann's law- Black body radiation- Optical radiation pyrometers- Disappearing filament photo electric pyrometer- Unchopped DC and chopped AC broad band radiation thermometers- Two colour radiation thermometers- Pneumatic and electrical temperature transmitters, Digital thermometers.	10
	Pressure measurement: Introduction to static and dynamic pressure, unit of pressure and conversions, differential pressure elements – U tube manometer – inclined manometer- ring balanced type manometer, elastic transducers like ordinary and diaphragm, bourdon tube, bellows, capsules etc. sealed pressure gauges, differential pressure transducers –pneumatic and electrical pressure transmitters, pressure switches and strain gauge pressure pickups, methods for measurement of vacuum Pirani Gauge, Mclead Gauge, Knudsen Gauge, very high pressure measurement, Calibration of pressure instruments	10

Unit-2	**Measurement of flow rate:** Classification of fluid flow, Variable headmeters for incompressible and compressible, Differential pressure meter(primary elements)- theory, construction and applications of orifice plate, venturimeter, flow nozzle, pitot tube, dall tube. Variable area type flow meters, Pressure taps- Manometers, differential pressure measurement- Square root extraction. Magnetic Meter, Turbine Meter, Vortex Meter, Mass Flow Meter. Ultrasonic Meter, Thermal Flow Meter. Positive Displacement Meters. Calibration of floe meters	16
	Level measurement: visual level indicators, differential pressure, ordinary float type, purge method, Buoyancy method, resistance probes for level measurement, capacitive level meter, ultrasonic level measurement, Gamma rays level measurement, microwaves, level limit switches, level measurement of closed vessel. measurement of level of solids- paddle wheel type	12

Recommended Books-

1. Andrew and Williams, *Applied instrumentation in process industries*, Vol. - 1/2/3, Gulf professional.
2. Austin E. Fribance, *Industrial instrumentation fundamentals*, McGraw hill, 1984.
3. B. G. Liptak, *Instrument Engineers Handbook*, Vol- 1, CRC Press, 2003.
4. D. Patranabis, *Principles of industrial instrumentation*, 2nd edition,TMH, 2005
5. E. B. Jones, *Instrument technology*, 3rd edition, Newnes-Butterworths, 1974.
6. Ernest O. Doebelin, *Measurement Systems: Application and Design*, 5th edition, McGraw-Hill Higher Edu., 2003.
7. Fairgeyer & Okun, *Water and Waste Water Technology*, 3rd edition, John Wiley and Sons, 2010.
8. R. K. Jain, *Mechanical and Industrial Measurements*, 12th edition, Khanna Publishers, 2013.

Subject Code : IEO-62*
Title of the course : Process 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: Learn the basic building blocks of P&I diagrams of various industrial processes.
CO2: Exercise the graphical symbols, standards and specification of various elements and process variables
CO3: Acquire the knowledge of the process flow diagrams of various industrial processes like cement, steal, textiles etc.
CO4: Employ the different instrumentation techniques for measurement of process parameters

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

Theory:

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**P& I diagrams:** Reading and drawing of instrumentation diagrams. Flow sheet symbols-ANSI symbols for 1) lines, 2) Valves, 3) heat transfer, 4) dryer, 5) material handling equipment, 6) storage vessel, 7) turbine/compressor, 8) flowsheet codes and lines, 9) graphical symbols for pipe fittings, valves and piping. Instrumentation symbols, standards, specifications-one line diagram of typical measurement and control schemes for flow, temperature, pressure and other process variables. One line diagram of typical pneumatic, hydraulic & electrical instrumentation systems.	20
	Process Flow Diagrams of Industries: cement, steel, chemical, petrochemical, food, paper textile etc.	10
	Instrumentation and control: boiler, chiller, distillation column, compressor, cooling tower, heat exchanger, steam turbine control water treatment , effluent and waste water treatment etc.	18

Recommended Books-

1. Andrew and Williams, *Applied instrumentation in process industries*, Vol.- 1/2/3, Gulf professional.
2. G N Pandey, *A text book of Chemical technology*, Vol-I & Vol-II, Vikas Publishing.
3. B. G. Liptak, *Instrument Engineers Handbook*, Vol- 1, CRC Press, 2003.
4. Mcmillan and Considine, *Process/Industrial Instruments and Controls Handbook*, 5th edition, McGraw-Hill Professional, 1999.

Subject Code : IET-624
Title of the course : Industrial Safety

L	T	P	Credits	Weekly Load
4	0	0	4	4

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

CO1: Understand that safety standards which must be maintained in compliance with regulatory requirements.

CO2: Demonstrate an understanding of workplace injury prevention, risk management, and incident investigation.

CO3: Demonstrate knowledge of different types of exposure and biological effects.

CO4: Acquire knowledge of contemporary issues of pollution and its control methods

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

Theory

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**Introduction:** Introduction to the concept of safety-Need-safety provisions in the factory Act-Laws related to the industrial safety-Measurement of safety performance, Safety Audit, Work permit system, injury and accidents-Definitions-Unsafe act – unsafe condition- causes, investigations and prevention of accidents, hazards, type of industrial hazards-nature, causes and control measures, hazard identifications and control techniques-HAZOP, FMEA,FMECA etc.	10
	Concept of Industrial hygiene, programmes: Recognition –Evaluation- Control, Noise- source –effects and noise control, exposure limits –standards, Hearing conservation programmes, Fire –fire load-control and industrial fire protection systems, Fire Hydrant and extinguishers, Electrical Hazards, protection and interlock-Discharge rod and earthling device, safety in the use of portable tools.	12
	Logics of consequence analysis: Estimation-Toxic release and toxic effects-Threshold limit values, Emergency planning and preparedness, Air pollution-classification- Dispersion modeling -pollution source and effects- -control method and equipments-Gravitational settling chambers-cyclone separators-Fabric filter systems-scrubbers etc.	12
Unit-2	**Concept of reliability:** Definition-Failure rate and Hazard function, System reliability models series, parallel systems, reliability hazard function for distribution functions-exponential normal –lognormal-weibull and gamma distribution.	12

Recommended Books-

1. C.S. Rao*, Environmental Pollution Control Engineering*, New Age International Limited,2007
2. Ian T. Cameron and Raghu Raman, *Process Systems Risk Management*, Elsevier Academic press,2005
3. Thomas J. Anton, *Occupational Safety and Health Management*, McGraw Hill,1979

Subject Code : IET-625
Title of the course : Machine Vision

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire knowledge of fundamentals of machine vision.
CO2: Process with gray scale images (edge detection, morphological operations)
CO3: Study the concept of line and circle detection.
CO4: Recognize the pattern matching techniques.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Fundamentals of Machine vision:** Machine vision, grey scale vs color image, basic image processing operations, basic image filtering techniques, thresholding techniques	08
	Edge detection: Basic theory of edge detection, template matching approach, Differential gradient operators, circular operators	08
	Morphological operations: Dilation, erosion and their properties, closing and opening, Hit and miss transform	08
Unit-2	**Edge detection:** Basic theory of edge detection, tempelate matching approach, Differential gradient operators, circular operators	08
	Line and Circle detection: Hough transform for line detection, Foot of normal method, Longitudinal line localization ,Hough based schemes for circular object detection	08
	Pattern matching techniques: Graphical approach to object location, maxima clique and other approaches, relational descripts.	08

Recommended Books-
1. Alexander Hornberg , *Handbook of machine vision* , Wiley-VCH,2006
2. E. R. Davies, *Machine Vision: Theory, Algorithms, Practicalities*, Morgan Kaufmann,2005
3. Harley R. Myler, *Fundamentals of Machine Vision* ,SPIE Press,1999

Subject Code : IET-626
Title of the course : Energy Management Auditing

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: To acquire an in depth knowledge about the energy management and auditing
CO2: Recognize how energy can be conserved and managed in industries.
CO3: Acquire a comprehensive idea on tariffs in Transmission &Distribution systems.
CO4: Be conversant in utilization and effects of energy on Environment.
CO5: Be competent to handle the Energy auditing procedure.

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

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Basics of Energy Conservation** Need of energy conservation and energy audit; Energy Intensive processes, Heating: methods/Techniques of energy Saving in Furnaces, Ovens and Boilers; Cooling: Methods/ Techniques of Energy Saving in Ventilating systems and Air Conditioners; Lighting energy: methods/Techniques of efficient lighting; Cogeneration -Types and Advantages	08
	Efficiency improvement in Motors Losses in Electrical Machines, Methods to reduce these losses, Efficient use of energy in motors with the help of voltage reducers, automatic star/ delta converters; Energy Efficient Motors: Construction, operation and characteristics; Power factor improvement devices and soft starters/Variable Frequency Drives.	08
	Energy Conservation In T&D Systems Reactive power compensation, demand side management, system voltage optimization and phase current balancing, Losses in transmission and distribution system and its minimization; Amorphous Core Transformers	08
Unit-2	**Tariff and Energy Conservation in Industries** Energy cost and Recent Electricity Board tariffs, Application of Tariff System to reduce Energy bill, Energy Conservation by improving load factor and power factor;	06
	Energy and the Environment Environment and social concerns related to energy utilization, The green house effect, Global Warming and its effect , Pollution, Acid Rains, Global Energy and environment Management	04

	Energy Audit Procedure of Energy audit, Selective Inventory Control analysis, Energy Flow Diagram and its importance, Measurements in energy audit and various measuring instruments, Questionnaires for the energy audit, internal energy audit checklist, Equipment used for energy conservation, Calculation of payback period for energy conservation equipment. IE rules and regulations for energy audit, Electricity act 2003	14

Recommended Books-

1. Bureau of Energy Efficiency, Bureau of Energy Efficiency Handbooks.
2. C.L. Wadhwa, Generation Distribution & Utilization of Electrical Energy, New Age international,1989
3. G Petrecca ,Industrial Energy Management: Principles & applications, Kluwer Academic Publisher,1993

Subject Code : IET-627
Title of the course : Reliability Engineering

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire knowledge on the techniques of reliability engineering
CO2: Apply learned concepts for improving the maintainability, hazard risk and the safety of a plant.
CO3: Analyze a failure mode effect and carry out criticality analysis.
CO4: Study and implement the techniques of reliability allocation.

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

Theory

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**Introduction:** Introduction, Importance of reliability, Reliability functions, Failure and Failure Modes, causes of failure, Instantaneous failure rate, General reliability Function.	08
	Component Reliability and Hazard Model: Component reliability from Test data, failure data (Failure density, failure rate, reliability, probability of failure) mean failure rate MTTF, MTBF. Hazard Models (Time dependent Hazard models, Constant Hazard model, Linear Hazard model, on-linear hazard model	08
	System Reliability: Reliability evaluation of non-maintained systems, series, parallel, series- parallel, non-series, standby configuration, k out of n configuration, complex system, Markov's Method, Fault tree technique, Event space, path Tracing methods, cut-set and tie set method	08
Unit-2	**Reliability Improvement:** Introduction, Improvement of components, redundancy: standby with perfect and imperfect switching .Comparison of component redundancy to system/unit redundancy, mixed redundancy, stand by redundancy	08
	Reliability Allocation: Introduction, Redundancy allocation and techniques for reliability allocation	06
	Availability and Maintainability: Concepts of reliability ,availability and maintainability, types of availability, objectives of maintenance, classification and factor effecting maintenance, maintenance levels, Inventory control of spare parts, Preventive maintenance of some electrical appliances	10

Recommended Books-
1. A.K. Govil , *Reliability Engineering* By, Tata McGraw Hill,1983
2. E. Balagurusamy ,*Reliability Engineering*, Tata McGraw Hill,1984
3. K.K. Aggarwal, *Reliability Engineering*, Kluwer academic Publications,1993
4. L S Srinath ,*Reliability Engineering* , 4th Edition,East-West Press, 2005.

Subject Code : IET-623
Title of the course : Biomedical Instrumentation

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

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

CO 1: Understand basicnervous, circulatory and respiratory system and origin of biopotentials.
CO 2: Utilize the concept of various bioelectric signals and electrodes for EEG, EMG and ECG.
CO 3: Have competency to acquire the data of cardiovascular, electrical activity of brain and respiratory system.
CO 4: Exercise knowledge medical imaging, computerized ultrasonic diagnosis and types, X-Rays and computerized tomography and use them in diagnosisof disease.
CO 5: Learn physiological parameters and components of biotelemetry system and their applications in medical field.

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

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

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Physiological systems of body:** Brief description of nervous, circulatory and respiratory systems, the body as a control system, the nature of bioelectricity, the origin of biopotentials.	06
	Bio electric Signals And Electrodes: Electro conduction system of the heart, the ECG Waveform, Neuron potential, muscle potential, electrodes for biophysical sensing, Skin-contact-impedance, electrodes for EEG,EMG and ECG, electrical conductivity of electrode jellies and creams.	06
	Cardiovascular measurements: The standard lead system, the Electrocardiography(ECG) preamplifier; ECG machines, Cardiac monitors, blood pressure measurements, direct and indirect, blood flow measurements, phonocardiography, defibrillators, pacemakers	06
	Measurements of Electrical Activity in Brain: Anatomy of Human Brain and Nerve Cell, Electroencephalography (EEG) electrodes and the 10-20 system, EEG amplitude and frequency bands, simplified block diagram, preamplifiers and EEG system specifications, EEG diagnostic uses and sleep patterns, visual and auditory evoked potential recordings, EEG system artifacts.	06
Unit-2	**Electromyography(EMG):** Muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, electrodes, signal conditioning and processing, Block diagram & description of Electromyography (EMG).	04
	Respiratory System Measurements: Respiratory anatomy, parameters of respiration, regulation of respiration, respiratory system measurements, respiratory transducers	08

	and instruments, spirometry.	
	Medical Imaging: Introduction to Medical Imaging, Computers in Medical Imaging, Computerized Ultrasonic Diagonosis and types, X-Rays, Computerized Tomography, Computerized Emission Tomography	08
	Biotelemetry: Physiological parameters adaptable to bio-telemetry, Components of a biotelemetry system, Implantable units, Applications of telemetry system in patient care.	04

Recommended Books:

1. John G. Webster, *Medical Instrumentation*, 3rd edition WSE, 2007
2. Joseph J Carr, John M. Brown, *Introduction to Biomedical Equipment Technology*, , 4th edition PE, 2000
3. L Cromwell, *Biomedical instrumentation and measurement*, 2nd edition, Prentice Hall (India), 1990
4. R.S. Khandpur, *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 2003

Subject Code : IEP-621
Title of the course : Microcontroller and Embedded System

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO 1: Study 8051 microcontroller along with its the internal architecture.
CO 2: Develop assembly language programming of 8051 microcontroller for simple arithmetic operations.
CO 3: Create program for frequency generation using interrupts, perform interfacing for 8051 microcontroller.
CO 4: Develop program for HLL and LED display interfacing with microcontroller
CO 5: Create program for serial/parallel communication and alarm switching using interrupt.

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

To understand the practicability of **Microcontroller and Embedded System**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Analysis of 8051 Microcontroller, Architecture & command.
2. Write an Assembly Language Program (ALP) for the Addition & Subtraction of 8 bit no's.
3. Write an ALP for multiplication of Two 8 bit no's.
4. Write an ALP for Division of Two 8 bit no's.
5. Write an ALP to find smallest & largest no in a given array.
6. Write an ALP to generate 10 KHz frequency using interrupt.
7. Write an ALP to interface intelligent LCD display with m C.
8. Write an ALP for m C & HLL for PC (VB/C++/VC++) to demonstrate/implement serial Interfacing.
9. Write an ALP to interface LED display.
10. Write an ALP to interface one m C with other using serial/parallel communication.
11. Write an ALP to switch ON alarm when m C receive interrupt

Subject Code : IEP-623
Title of the course : Biomedical Instrumentation

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Practice various measurements on human body using thermistor, physiopac and Biofeed back kit.
CO 2: Measure the blood pressure and blood sugar level.
CO 3: Practice recording ECG, identify various components on graph and study QRS detection circuit.
CO 4: Exercise EMG signal analysis for unipolar and bipolar electrodes; EEG signal.
CO 5: Analyze rest and exercise ECG on TMT machine, practice use of spirometer.

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

To understand the practicability of **Biomedical Instrumentation**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To measure the respiration rate of human body with the help of Thermistor as a transducer.
2. To measure the pulse rate of human body with the help of physiopac .
3. To measure the GSR of human body using Biofeed back kit.
4. To measure the blood pressure using sphygmomanometer and Stethoscope.
5. To measure the blood pressure using OMRON kit.
6. To study the Blood sugar device.
7. Record ECG using student physiograph and identify P, Q, R, S and T components on the graph.
8. To study the QRS detection circuit and find out heart rate using R-R interval.
9. Compare the EMG signal obtained from unipolar and bipolar electrodes.
10. To study the characteristics of EEG signal.
11. Analyze the rest ECG and exercise ECG on TMT machine.
12. To Study the health of lungs with the help of spirometer.

Title of the course : Industrial Training

L	T	P	Credits	Weekly Load
-	-	-	8	6 weeks

Course Outcomes:

After successful completion of industrial training, the students should be able to

CO 1: Implement the project requiring individual and teamwork skills.

CO 2: Correlate the theoretical concepts with the real life industrial environment.

CO 3: Gather and analyze the scientific information.

CO 4: Communicate their work effectively through writing and presentation.

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

Objective of the programme is to

1. Enrich the students with a basic understanding of the Instrumentation Engineering, towards developing a holistic perspective to understand various practical issues and latest trends in the field.
2. Familiarize and provide “hands on” training experience with the requisite simulation, design, and analytical tools and techniques.
3. Achieve a long term goal of transforming themselves into a brilliant blend of theoretician and practicing engineer.
4. Introduce the way of troubleshooting various engineering faults related to respective fields.
5. Make the students able to present work in written, oral or formal presentation formats.

Subject Code : IEO-711
Title of the Course : Analytical 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: Differentiate between analytical and other measuring instruments.
CO 2: Apply the principle of spectrometry and chromatography in industrial application
CO 3: Learn the concept of electron microscopy, SEM and TEM and their applications.
CO 4: Demonstrate the application of Potentiometry and gas analyzer
CO 5: Understand the data presentation and statistic analysis of analytical instruments .

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Difference between analytical and other instruments, sampling, sampling system for liquids and gases, sampling components, automatic and faithful sampling.	06
	Spectrometry : Electromagnetic Radiation, Radiation Sources, Optical Sources and Detectors, Beer's Lamberts Law, UV ,IR and Visible Spectrophotometer, Flame Photometer and Atomic Absorption Spectrometer : Basic principle , block diagram and related instrumentation Basic principle, block diagram and related instrumentation of X-ray analyzers, NMR spectrometry, Mass spectrometry and its types.	06
	Chromatography: Basic Principle and Types of Chromatography: Types, Block Diagram and related instrumentation of gas and Liquid Chromatography.	06
Unit-2	**Electron microscopy:** Introduction, types of electron microscopy: Scanning electron microscope (SEM) and transmission electron microscopy (TEM), Difference between optical microscopy, SEM and TEM	06
	Gas analyzer: Types: paramagnetic oxygen analyzer, IR gas analyzer, thermal conductive gas analyzer, analyzer based on gas density	06
	Potentiometry: Electro chemical cell, Ion sensitive Electrodes, Solid state sensors, gas sensing electrode, bio catalytic membrane electrode.	06
	Data presentation and analysis: Analytical data presentation , error analysis	06

Recommended Books:

1. R. S. Khandpur, *Handbook of Analytical Instruments*, McGraw-Hill Education , 2015.
2. R. P. Khare, *Analysis Instrumentation: An Introduction.*, CBS Publisher, 2008.
3. Patranabis, *Principles of Industrial Instrumentation*, Tata McGraw-Hill Education, 2001.
4. Willard, H.H., L.L. Jr. Merritt, J.A. Dean, and F.A. Jr. Settle, *Instrumental methods of analysis.* Wads Worth , 1988.

Subject Code : IET-713
Title of the course : Image processing

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Exercise basics of digital image generation, processing, sampling and quantization.
CO 2: Understand image transforms techniques and image enhancement techniques.
CO 3: Be conversant in 2-D system, spectral density function, estimation and information theory.
CO 4: Analyze image restoration including models, filters and digital processing.
CO 5: Develop process of image segmentation, image data compression and associated techniques.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Definition of image, generation of image, steps in image processing, elements of digital image processing systems, image enhancements, restoration and analysis	06
	Digital image fundamentals: Elements of visible perception, image model, sampling and quantization, relationships between pixels, imaging geometry.	06
	Image transforms: Introduction to Discrete Fourier Transform (D.F.T.), 2-D.F.T., Fast Fourier Transform (F.F.T.), other seperable image transforms (walsh, hadamard, discrete cosine, haar, slant, KL)	06
	Image enhancements: Point operations, histogram modeling, spatial filtering-smoothing, sharpening, low pass, high pass, homomorphic filtering.	06
Unit-2	**2-D systems and mathematical preliminaries:** Introduction and definitions, matrix theory, random signals, spectral density function, results from estimation and information theory.	06
	Image restoration: Image observation models, inverse and wiener filtering, Finite Impulse Response (F.I.R.) wiener filters, filtering using image transforms, least squares filters, generalized inverse, Singular Value Decomposition (S.V.D.) and interactive methods, recursive filtering, causal models, digital processing of speckle images, maximum entropy restoration.	06
	Image segmentation: Detection of discontinuities, age linking and boundary detection, thresholding region oriented segmentation, use of motion in segmentation.	06
	Image data compression: Introduction, pixel coding, predictive techniques (PCM, DPCM, etc), transform coding theory of images, hybrid coding and vector Differential Pulse Code Modulation (DPCM)	06

Recommended Books-

1. A. K. Jain, *Fundamental of Digital Image Processing*., PHI 2nd edition, 1995.
2. B. Chanda and D. Dutta Majumdar, .*Digital Image processing*., PHI, 2000.
3. C. Phillips, .*Image Processing in C*., BPB Publication, 1995.
4. Don Pearson, *Image Processing. (The ESSEX series in Telecommunication an information systems*, McGraw Hill International ELTL engg. series), 1991.
5. Emmauel C. Ifeachor and Barry W. Jervis, .*Digital Signal Processing*., Pearso Education, 2nd edition, 2000.
6. Johnny Johnson, .*Introduction to DSP*., PHI . 1996.
7. Proakis, .*DSP*. , PHI 1997
8. R. C. Gonzalez, .*Image Processing*, Pearson Education 2nd edition, 1999.
9. W. K. Pratt, .*Digital Image Processing*., John Wiley and Sons, 1994.
10. Rabnier Gold, .*Theory and Application of DSP*, PHI, 1996.
11. Milan Sonka, Vaclav Hlavac, .*Image Processing analysis and machine vision*., Thomson Learning, 2nd edition, 1999.

Subject Code : IET-714
Title of the course : Introduction to MEMS

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire the knowledge of Micro-Electro-Mechanical Systems (MEMs) and its scope.
CO2: Learn the Bulk Micromachining process.
CO3: Be conversant in classification and working of Physical Microsensors.
CO4: Learn the various Fabrication Techniques.
CO5: Acquire the knowledge of Surface Micromachining.

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

Theory

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**Introduction:** Historical Background: Silicon Pressure sensors, Micromachining, Micro Electro Mechanical Systems. Microfabrication and Micromachining: Integrated Circuit Processes. Potential of MEMS in industry.	06
	Bulk Micromachining: Bulk Micromachining : Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA)	06
	Physical Microsensors: Physical Microsensors: Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor Principles and Examples: Thermal sensors, Electrical Sensors, Mechanical Sensors, Chemical and Biosensors. Microactuators: Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotorsMicroactuator systems: Success Stories, Ink-Jet printer heads, Micro-mirror TV Projector.	12
Unit-2	**Fabrication Techniques-I:** Microstereolithography (MSL) for 3D fabrication, Two photon MSL, Dynamic mask MSL, scanning systems, Optomechatronics system for MSL. Ceramic and Metal Microstereolithography.	08
	Fabrication Techniques-II: Ceramic and Metal Microstereolithography. Scattering of light by small particles. Effect of particle properties on accuracy and resolution of component in Ceramic and Metal MSL. Monte carlo ray tracing method. Nanolithography.	08
	Surface Micromachining: Surface Micromachining: One or two sacrificial layer processes, Surface micromachining requirements, Polysilicon surface micromachining, Other compatible materials, Silicon Dioxide, Silicon, Micromotors, Gear trains, Mechanisms. Characterization of MEMS devices	08

Recommended Books-

1. Kovacs, *Micromachined Transducers Sourcebook*, WCB McGraw-Hill, 1998.
2. Marc J. Madou, *Fundamentals of Microfabrication*, 2nd edition, CRC Press, 2002.
3. M-H. Bao, Elsevier, *Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscope*s, New York, 2000.
4. Nitaigour Mahalik, *MEMS*, 1st edition, McGraw Hill Education, 2007.
5. Rai Chaoudhary, *MEMS and MOEMS Technology and Applications*, SPIE Publications, 2000.
6. Stephen D. Senturia, *Microsystem Design*, Springer, 2005.
7. Tai- Ran Hsu, *MEMS and Microsytems: Design, Manufacture, and Nanoscale Engineering*, 2nd edition, John Wiley and Sons, 2008.
8. Vijay Vardan, *MEMS*, 1st edition, Wiley Publication, 2002.

Subject Code : IET-715
Title of the course : Biomedical Signal Processing

L	T	P	Credits	Weekly Load
4	0	0	4	4

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

CO1: Acquire the knowledge of Bio electric amplifiers, Bio potentials and Cardiovascular measurements.

CO 2: Identification of problems ofphysical challenged persons andsolutions for the improvement of social life. .

CO 3: Understand the concept about telemedicine,its classification and applications in medical field.

CO 4: Know about image compression techniques and security in biomedical Signal Processing.

CO 5: Learn about the hospital data management that include hospital information system, efficiency, security and cost effectiveness of computer records.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Bio electric Amplifiers:** Bioelectric Amplifiers, Operational Amplifiers, Basic Amplifier Configurations, Multiple-Input Circuits, Differential Amplifiers, Signal Processing Circuits, isolation Amplifiers, Chopper Stabilized Amplifiers, Input grounding.	08
	Bio potentials: Electroneurogram (ENG), EMG, ECG, Electroretinogram (ERG), Electroencephalogram EEG, Magnetoencephalography (MEG) and Electro-oculogram (EOG).	06
	Cardiovascular measurements: Hemodialysis, Lithotripsy, Ventilators, Infant Incubators, Drug Delivery Devices, Surgical Instruments, Therapeutic Applications of the Laser.	08
Unit-2	**Aids for Handicapped:** Computer aids for blind and visually handicapped and deaf.	06
	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 DICOM and 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.	08
	Hospital Data Management: Hospital Information System, Functional capabilities of Computerized Hospital Information System, Efficiency, Security and Cost Effectiveness of Computer Records, Computerized Patient Data Management.	08

Recommended Books:

1. John G. Webster, *Medical Instrumentation*, 3rd edition WSE, 2007
2. Joseph J Carr, John M.Brown, *Introduction to Biomedical Equipment Technology*, , 4th edition PE, 2000
3. L Cromwell,*Biomedical instrumentation and measurement*, 2nd edition, Prentice Hall (India), 1990
4. RS Khandpur, *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 2003

Subject Code : IET-716
Title of the course : Non-Conventional Energy Resources

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire knowledge on fundamentals of solar energy and its storage methods.
CO2: Study the methods of collection of solar energy.
CO3: Analyze the performance characteristics of wind energy.
CO4: Understand and demonstrate the principles of various renewable energy resources.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Principles of Solar Radiation:** Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.	08
	Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.	06
	Solar Energy Storage And Applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.	06
	Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria	04
Unit-2	**Bio-Mass:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.	10
	Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.	04
	Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.	06
	Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, principles of DEC.	04

Recommended Books-
1. D.P. Kothari and K.C. Singhal, *Renewable energy sources and emerging technologies*, P.H.I.2011
2. G.D Rai, *Non Conventional Energy Sources*, Khanna Publishers, 2005.

3. K M. Mittal, *Non-Conventional Energy Systems*, Wheeler Publishing Co. Ltd, New Delhi, 2003
4. Ramesh R & Kumar K U, *Renewable Energy Technologies*, Narosa Publishing House, New Delhi, 2004
5. Twidell & Wier, *Renewable Energy Resources*,2nd Edition, CRC Press(Taylor & Francis),2006
6. Tiwari and Ghosal, *Renewable energy resources*, Narosa Publishing house,2007

Subject Code : IET-711
Title of the course : Digital 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

CO 1: Exercise discrete Fourier transform (DFT), its properties, convolution and associated methods.
CO 2: Understand Fast Fourier transform (FFT), decimation in time and frequency.
CO 3: Develop Finite Impulse Response (FIR), Infinite Impulse Response (IIR) filter and analyze their design techniques
CO 4: Analyze structure of FIR and IIR filters for direct, cascade and parallel arrangement.
CO 5: Develop DSP architecture with memory, data addressing, and address generation unit.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**The discrete Fourier Transform:** Definition of DFT and relation to Z-transform, Properties of the Discrete Fourier Transform (DFT), Linear and periodic convolution using the DFT, Zero padding, spectral leakage, Resolution and windowing in the DFT.	08
	The Fast Fourier transform: Decimation in time Fast Fourier Transform (FFT), Decimation in frequency FFT. Positive Displacement	08
	Finite Impulse Response (FIR) filters: Window design techniques, Kaiser window design technique, Equiripple approximations.	08
Unit-2	**Infinite impulse response (IIR) filters:** Bilinear transform method, Examples of bilinear transform method.	08
	Structures and Properties of FIR and IIR filters and review: IIR - Direct, parallel and cascaded realizations., FIR – Direct and cascaded realizations, Coefficient quantization effects in digital filters	08
	Introduction to DSP Processor Architecture: Basic architectural features, DSP processor computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation unit	08

Recommended Books:

1. J. Proakis, D. Manolakis. *Digital Signal Processing: Principles, Algorithms and Applications*. Prentice-Hall, 2006.

2. MathWorks, Inc., South Natick,. *MATLAB Reference Guide: High-Performance Numeric Computation and Visualization Software*. The MathWorks, 1984.
3. McClellan, J. *Computer-Based Exercises for Signal Processing Using MATLAB 5*. Prentice Hall, 1997.
4. T. W. Parks, C. S. Burras. *Digital Filter Design*. J. Wiley & Sons, 1987.

Subject Code : IET-712
Title of the course : Process Plant Instrumentation

L	T	P	Credits	Weekly Load
4	0	0	4	4

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

CO1: Learn the basic building blocks of P&I diagrams of various industrial processes.
CO2: Exercise the graphical symbols, standards and specification of various elements and process variables
CO3: Acquire the knowledge of the process flow diagrams of various industrial processes like cement, steal, textiles etc.
CO4: Employ the different instrumentation techniques for measurement of process parameters

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

Theory:

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**P& I diagrams:** Reading and drawing of instrumentation diagrams. Flow sheet symbols-ANSI symbols for 1) lines, 2) Valves, 3) heat transfer, 4) dryer, 5) material handling equipment, 6) storage vessel, 7) turbine/compressor, 8) flowsheet codes and lines, 9) graphical symbols for pipe fittings, valves and piping. Instrumentation symbols, standards, specifications-one line diagram of typical measurement and control schemes for flow, temperature, pressure and other process variables. One line diagram of typical pneumatic, hydraulic & electrical instrumentation systems.	20
	Process Flow Diagrams of Industries: cement, steel, chemical, petrochemical, food, paper textile etc.	10
	Instrumentation and control: boiler, chiller, distillation column, compressor, cooling tower, heat exchanger, steam turbine control water treatment , effluent and waste water treatment etc.	18

Recommended Books-

5. Andrew and Williams, *Applied instrumentation in process industries*, Vol.- 1/2/3, Gulf professional.
6. G N Pandey, *A text book of Chemical technology*, Vol-I & Vol-II, Vikas Publishing.
7. B. G. Liptak, *Instrument Engineers Handbook*, Vol- 1, CRC Press, 2003.
8. Mcmillan and Considine, *Process/Industrial Instruments and Controls Handbook*, 5th edition, McGraw-Hill Professional, 1999.

Subject Code : IEP-711
Title of the course : Virtual Instrumentation Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Understand the basics and simple operations of LabView.
CO 2: Learn the basic programming concepts in LabVIEW.
CO 3: Acquire knowledge of different Data Acquisition System concepts.
CO 4: Develop real time applications using LabVIEW.

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

To understand the practicability of **Virtual Instrumentation**, the list of experiments is given below to be performed in the laboratory.

1. Getting started with LabView. basic operations, controls, and indicators, simple programming structures.
2. LabView: Debugging a VI and Sub VI.
3. LabView: Traffic light programming.
4. Basics of GPIB. Setting up GPIB, address, simple read/write.
5. Communication via RS-232/serial port.
6. LabView: Incorporating user written C routine.

Subject Code : IEP-712
Title of the course : Project Minor

L	T	P	Credits	Weekly Load
0	0	4	2	4

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

CO 1: Implement the project requiring individual and teamwork skills.
CO 2: Use research based knowledge in the field of instrumentation engineering and multi-disciplinary areas.
CO 3: Carry out design calculations and implementations in the area of project.
CO 4: Communicate their work effectively through writing and presentation.
CO 5: Handle professional responsibilities and respect for ethics.

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

Objective of the programme is to:

1. Make students able to demonstrate the ability to collaborate with others as they work on intellectual projects.
2. Provide a platform to the students to implement their technical skills on a given/selected task.
3. Design solutions for real life problems using engineering knowledge.
4. Prepare a Written Report on the Study conducted for presentation .
5. Final Seminar, as oral Presentation before respective Project Coordinator.

Subject Code : IEO-721
Title of the course : Biomedical Signal Processing

L	T	P	Credits	Weekly Load
4	0	0	4	4

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

CO1: Acquire the knowledge of Bio electric amplifiers, Bio potentials and Cardiovascular measurements.

CO 2: Identification of problems ofphysical challenged persons andsolutions for the improvement of social life. .

CO 3: Understand the concept about telemedicine,its classification and applications in medical field.

CO 4: Know about image compression techniques and security in biomedical Signal Processing.

CO 5: Learn about the hospital data management that include hospital information system, efficiency, security and cost effectiveness of computer records.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Bio electric Amplifiers:** Bioelectric Amplifiers, Operational Amplifiers, Basic Amplifier Configurations, Multiple-Input Circuits, Differential Amplifiers, Signal Processing Circuits, isolation Amplifiers, Chopper Stabilized Amplifiers, Input grounding.	08
	Bio potentials: Electroneurogram(ENG), EMG, ECG, Electroretinogram (ERG), Electroencephalogram EEG, Magnetoencephalography (MEG) and Electro-oculogram (EOG).	06
	Cardiovascular measurements: Hemodialysis, Lithotripsy, Ventilators, Infant Incubators, Drug Delivery Devices, Surgical Instruments, Therapeutic Applications of the Laser.	08
Unit-2	**Aids for Handicapped:** Computer aids for blind and visually handicapped and deaf.	06
	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 DICOM and 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.	08
	Hospital Data Management: Hospital Information System, Functional capabilities of Computerized Hospital Information System, Efficiency, Security and Cost Effectiveness of Computer Records, Computerized Patient Data Management.	08

Recommended Books:

5. John G. Webster, *Medical Instrumentation*, 3rd edition WSE, 2007
6. Joseph J Carr, John M. Brown, *Introduction to Biomedical Equipment Technology*, , 4th edition PE, 2000
7. L Cromwell, *Biomedical instrumentation and measurement*, 2nd edition, Prentice Hall (India), 1990
8. R.S. Khandpur, *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 2003

Subject Code : IET-721
Title of the course : Modelling and Simulation

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Be conversant in systems modeling and their computer simulation.
CO 2: Understand simulation of continuous and discrete system with various distribution methods.
CO 3: Analyze simulation experiments, learn to verify results and terminate running simulation.
CO 4: Develop knowledge of simulation languages, their features and various operations.
CO 5: Model stochastic network using simulation and its merits.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Introduction - systems and models - computer simulation and its applications	04
	System Simulation: Continuous system simulation - modeling continuous systems - simulation of continuous systems - discrete system simulation - methodology – event scheduling and process interaction approaches - random number generation -testing of randomness - generation of stochastic variates - random samples from continuous distributions - uniform distribution – exponential distribution m-Erlang distribution - gamma distribution - normal distribution – beta distribution - random samples from discrete distributions - Bernoulli - discrete uniform - binomial - geometric and poisson	10
	Evaluation and Validation: Evaluation of simulation experiments - verification and validation of simulation experiments - statistical reliability in evaluating simulation experiments -confidence intervals for terminating simulation runs	10
	Simulation Languages: simulation languages -programming considerations – general features of GPSS - SIM SCRIPT and SIMULA. Simulation of queueing systems - parameters of queue - formulation of queueing problems - generation of arrival pattern - generation of service patterns -Simulation of single server queues - simulation of multi-server queues -simulation of tandom queues.	08
Unit-2	**Simulation of Various Networks:** Simulation of stochastic network - simulation of PERT network - definition of network diagrams - forward pass computation - simulation of forward pass -backward pass computations - simulation of backward pass - determination of float and slack times determination of critical path - simulation of complete network - merits of simulation of stochastic networks.	12

Recommended Books

1. Deon, C. *System Simulation And Digital Computer*. Prentice Hall of India.
2. G., Gordan. *System Simulation*. Prentice Hall of India., 1989.
3. Law A.M., Ketton W.D. *Simulation Modelling and Analysis*. McGraw Hill, 2000.

Subject Code : IET-722
Title of the course : Electromagnetic Field Theory

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Understand vector analysis, curl, gradient, divergence and laws of static electric field.

CO 2: Analyse steady and time varying magnetic field, basic laws, vector representation, steady state equation, Poynting Vector etc.

CO 3: Interpret EM wave propagation in homogeneous, conducting and dielectric mediums.

CO 4: Differentiate reflection & refraction of EM waves by perfect conductor, dielectric and insulator.

CO 5: Analyze Transmission line travelling & standing waves, characteristic impedance, reflection coefficient.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										W
CO2		M		M								
CO3				M		W				S		
CO4				M						W		
CO5				M		M				M		

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Review of Vector Analysis** Vector analysis, Physical interpretation of gradient, divergence and curl; vector relations in other coordinate systems, integral theorems: divergence theorem, stoke's theorem, green's theorem and Helmholtz theorem.	5
	Static Electric Field Introduction to fundamental relations of electrostatic field; Gauss's law and its applications; potential function; Field due to continuous distribution of charges; Equipotential surfaces; Divergence theorem; Poisson's equation and Laplace's equation, capacitance, electrostatic energy, Conditions at Boundary between dielectrics, Uniqueness theorem.	5
	Steady Magnetic Field	6

	Magnetic induction and Faraday's laws Ampere's work Law in differential vector form, magnetic field due to volume distribution of current and the Dirac-delta function, ampere's force law magnetic vector potential, Analogies between electric and magnetic fields, steady state equation of continuity.	
	Time Varying Fields Maxwell's Equations Equation of continuity for time varying fields, Inconsistency of ampere's law, Maxwell's equations in integral and differential form for static and time varying fields, conditions at a Boundary surface, Concept of Poynting vector, Poynting Theorem, Interpretation of ExH	5
Unit-2	**Electromagnetic Waves Propagation** Solutions for free-space conditions, electromagnetic waves in a homogeneous medium, propagation of uniform plane-wave, relation between E & H in a uniform plane-wave, wave equations for conducting medium, Maxwell's equations using phasor notation, wave propagation in a conducting medium, conductors, dielectrics, wave propagation in good conductor and good dielectric, depth of penetration, polarization	6
	Reflection Of Electromagnetic Waves Electromagnetic wave Reflection by Perfect Conductor -normal and oblique incidence, Perfect Dielectric-normal incidence, Perfect Insulator –Oblique incidence;. reflection at the surfaces of a conductive medium, surface impedance	5
	Refraction of Electromagnetic Waves Electromagnetic wave refraction at the surface of a perfect conductor & perfect dielectric (both normal incidence as well as oblique incidence), Brewester's angle and Total internal reflection, and applications	5
	Trasmission Line Theory Transmission line as a distributed circuit, transmission line equation, travelling & standing waves, characteristic impedance, input impedance of terminated line, reflection coefficient, Voltage Standing Wave Ratio (VSWR), Smith's chart and its applications.	5

Recommended Books-

1. Jordan C. Edward and Balmain G. Keith, Electromagnetic Waves and Radiating Systems,2nd Edition, Prentice-Hall Inc, 1968.
2. John D. Kraus, Electromagnetics, 5th Edition, McGraw-Hill Publishers, 2005.
3. Joseph A. Edminister, Schaum's Theory and Problems of Electromagnetics, 4th Edition, McGraw-Hill, 2013.
4. Narayan N. Rao, Elements of Engineering Electromagnetics, 6th Edition,Pearson Education, 2004.
5. Hayt, Engineering Electromagnetics, 7th Edition, Tata McGraw-Hill, 2012.

Subject Code : IET-723
Title of the course : Nuclear Instrumentation

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Interpret the working of nuclear system, its basics and radiation detection techniques.
CO 2: Understand electronic and counting system, various analyzers and Energy Resolution.
CO 3: Be conversant in nuclear instrumentation system in industries.
CO 4: Analyze application of nuclear instruments in medicine and health care.
CO 5: Know various safety aspect, shielding and emergency schemes.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Introduction to properties of Nuclear system and Radiation, Interaction of radiation with matter ,General Properties of Nucleus, Radioactivity, Nature of Nuclear Radiations, Characteristic properties of radioactive radiations, Properties of Alpha, Beta, and Gamma rays, Natural and artificial radio-activity. Radioactivity Laws, Half life period, radioactive series, Isotopes and Isobars, Various effects-photoelectric, Compton scattering and pair production, stopping power and range of charged nuclear particles.	08
	Radiation detectors: Techniques for weak signal detection, Detectors for Alpha, beta and gamma rays, Detector classification. Ionization chamber, Regions of multiplicative operation, Proportional counter, Geiger Muller counter-volt ampere characteristics, Designing features, Scintillation detectors (Photomultiplier tube-types, dark currents, scintillators, pulse resolving power) , efficiency of detection, Signal To Noise Ratio (SNR) improvement, Solid state detectors (Lithium ion drifted -Si-Li, Ge-Li, Diffused junction, surface barrier)	10
	Electronics and counting systems: Pre-amp., main amplifiers, Discriminators, Scalars and count rate meters, Pulse shaping, pulse stretchers, Coincidence circuits, photon counting system block diagram, factors influencing resolution of gamma energy spectrum, Energy resolution in radiation detectors, single and multichannel analyzers (MCA),pulse height analyzers (PHA).	06
Unit-2	**Applications in industry:** Basic Nuclear Instrumentation system- block diagram, Nuclear Instrumentation for laboratory. Personal monitors like Thermo Luminescence Detectors (TLD), Dosimeters, Tele-detectors, which are used to assess the radiation exposure to the radiation plant workers. Nuclear Instrumentation for power reactor.	10

	Nuclear Instrumentation for Toxic fluid tank level measurement, Underground Piping Leak detection, weighing, thickness gauges, water content measurement etc. Agriculture applications like food irradiation.	
	Applications in medicines: Gamma camera- design, blockdiagram, medical usage. Radiation uptake studies- block diagram and design features. Nuclear Instrumentation for health care, Radiation Personnel Health Monitors like neutron monitors, Gamma Monitors, Tritium monitors, Iodine monitors and PARA (particulate activity radiation alarms).	08
	Safety: Hazards of ionization radiation, physiological effect of radiation, Dose and Risk, Radiological protection-Shielding material and effectiveness. Operational safety instruments, Emergency schemes, affluent disposal, Applications to medical diagnosis and treatment.	06

Recommended Books-

1. G. F. Knoll, *Radiation Detection & Measurement*., 2nd edition, John Wiley & Sons,1998.
2. Gaur & Gupta, *Engineering Physics*.,Danpat Rai & Sons, 2001.
3. *Hand Book of Nuclear Medical Instruments*, TMH Publishing New Delhi, 1974.
4. Irvin Kaplan, *Nuclear Physics*,Narosa, 1987.
5. M.N. Avdhamule &P.G.Kshirsagar, .*Engineering Physics*, S. Chand & Co., 2001.
6. P.W.NICHOLSON, *Nuclear Electronics*, John Wiley, 1998.
7. R. M. Singru, *Introduction to Experimental Nuclear Physics*", Wiley Eastern Pvt. Ltd., 1974
8. S. S. Kapoor & V. S. Ramamurthy, *Nuclear Radiation Detectors*, Wiley Eastern Limited, 1986.
9. Washlete CCH and Hewitt SG, *Nuclear Instrumentation*, Newnes,1965

Subject Code : IET-724
Title of the course : Soft Computing

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Apply a soft computing methodology for a particular problem.

CO 2: Exercise fuzzy logic and reasoning to handle uncertainty and solve engineering problems.

CO 3: Implement genetic algorithms to combinational optimization problems.

CO 4: Utilize neural networks to pattern classification and regression problems.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Fuzzy Logic-I (Introduction):** Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.	08
	Fuzzy Logic –II (Fuzzy Membership, Rules): Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzifications, Fuzzy Controller, Industrial applications.	08
	Genetic Algorithm(GA): Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.	08
Unit-2	**Neural Networks-1(Introduction & Architecture):** Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.	08
	Neural Networks-II (Back propagation networks): Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting back propagation training, applications.	08
	Neuro Fuzzy Modelling: Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.	08

Recommended Books-

1. E. Goldberg Davis, "*Genetic Algorithms: Search, Optimization and Machine Learning*", Addison Wesley, N.Y., 1989.

2. J. Ross Timothy, "*Fuzzy Logic with Engineering Applications*", McGraw-Hill, International Editions, Electrical Engineering Series, Singapore, 1997.
3. J. S. R. Jang, C.T. Sun and E. Mizutani, "*Neuro-Fuzzy and Soft Computing*", PHI, 2004, Pearson Education 2004.
4. R. Eberhart, P. Simpson and R. Dobbins, "*Computational Intelligence - PC Tools*", AP Professional, Boston, 1996.
5. S. Rajasekaran and G. A. V. Pai, "*Neural Networks, Fuzzy Logic and Genetic Algorithms*", PHI, 2003.

Subject Code : IEP-721
Title of the course : Major Project

L	T	P	Credits	Weekly Load
0	0	8	4	8

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Implement the project requiring individual and teamwork skills.
CO 2: Update recent knowledge in the area of project.
CO 3: Carry out design calculations and implementations in the area of project.
CO 4: Communicate their work effectively through writing and presentation.
CO 5: Handle professional responsibilities and respect for ethics.

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

The objective of Project Work is to enable the student to take up investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment normally includes:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a Departmental Committee including external expert.

Subject Code : IEP-722
Title of the course : Seminar

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO 1: Communicate their work effectively through writing and presentation.
CO 2: Use research based knowledge in the latest area of technology.
CO 3: Engage in independent and life-long learning
CO 4: Implement the project requiring individual skills.

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

Objectives of the programme is to

1. Familiarize the students with the outside professional environment.
2. Make the students able to use the resources for the given problem/assignment.
3. Update the students with modern trends of Instrumentation and control 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.

Subject Code : IEP-523
Title of the course : Self Study Course Instrumentation and Control Engg.

L	T	P	Credits	Weekly Load
3	0	2	4	5

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

CO 1: Develop the competitive approach in solving problems of Instrumentation and control engineering.
CO 2: Be fluent in various fields of Instrumentation and control engineering
CO 3: Enhance the capability of time bound group study.
CO 4: Enhance inter disciplinary knowledge.

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

Syllabus

Section 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigen values and eigen vectors. Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series. Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems. Differential equations: First order equation (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's and Euler's equations, Initial and boundary value problems, Partial Differential Equations and variable separable method. Complex variables: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent' series, Residue theorem, solution integrals. Probability and Statistics: Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson,Normal and Binomial distribution, Correlation and regression analysis. Numerical Methods: Solutions of non-linear algebraic equations, single and multi-step methods for differential equations. Transform Theory: Fourier transform,Laplace transform, Z-transform. Electrical Engineering

Basics of Circuits and Measurement Systems:Kirchoff's laws, mesh and nodal Analysis. Circuit theorems. One-port and two-port Network Functions. Static and dynamic characteristics of Measurement Systems. Error and uncertainty analysis. Statistical analysis of data and curve fitting. Transducers,

Mechanical Measurement and Industrial Instrumentation: Resistive, Capacitive, Inductive and piezoelectric transducers and their signal conditioning. Measurement of displacement, velocity and acceleration (translational and rotational), force, torque, vibration and shock. Measurement of pressure, flow, temperature and liquid level.Measurement of pH, conductivity, viscosity and humidity.

Analog Electronics: Characteristics of diode, BJT, JFET and MOSFET. Diode circuits. Transistors at low and high frequencies, Amplifiers, single and multi-stage. Feedback amplifiers. Operational amplifiers, characteristics and circuit configurations. Instrumentation amplifier. Precision rectifier. V-to-I and I-to-V converter. Op-Amp based active filters. Oscillators and signal generators.

Digital Electronics: Combinational logic circuits, minimization of Boolean functions. IC families, TTL, MOS and CMOS. Arithmetic circuits. Comparators, Schmitt trigger, timers and mono-stable multi-vibrator. Sequential circuits, flip-flops, counters, shift registers. Multiplexer, S/H circuit.Analog-to-Digital and Digital-to-Analog converters. Basics of number system, .Microprocessor applications, memory and input-output interfacing. Microcontrollers.

Signals, Systems and Communications: Periodic and aperiodic signals. Impulse response, transfer function and frequency response of first- and second order systems. Convolution, correlation and characteristics of linear time invariant systems. Discrete time system, impulse and frequency response. Pulse transfer function. IIR and FIR filters. Amplitude and frequency modulation and demodulation. Sampling theorem, pulse code modulation. Frequency and time division multiplexing. Amplitude shift keying, frequency shift keying and pulse shift keying for digital modulation.

Electrical and Electronic Measurements: Bridges and potentiometers, measurement of R,L and C. Measurements of voltage, current, power, power factor and energy. A.C & D.C current probes. Extension of instrument ranges. Q-meter and waveform analyzer. Digital voltmeter and multi-meter. Time, phase and frequency measurements. Cathode ray oscilloscope. Serial and parallel communication. Shielding and grounding.

Control Systems and Process Control: Feedback principles. Signal flow graphs. Transient Response, steady-state-errors. Routh and Nyquist criteria. Bode plot, root loci. Time delay systems. Phase and gain margin. State space representation of systems. Mechanical, hydraulic and pneumatic system components. Synchro pair, servo and step motors. On-off, cascade, P, P-I, P-I-D, feed forward and derivative controller, Fuzzy controllers.

Analytical, Optical and Biomedical Instrumentation: Mass spectrometry. UV, visible and IR spectrometry. X-ray and nuclear radiation measurements. Optical sources and detectors, LED, laser, Photo-diode, photo-resistor and their characteristics. Interferometers, applications in metrology. Basics of fiber optics. Biomedical instruments, EEG, ECG and EMG. Clinical measurements. Ultrasonic transducers and Ultrasonography. Principles of Computer Assisted Tomography.