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 learning in the field of Electrical and Instrumentation Engineering.
- 5. To interact with the industry, educational and research organizations, and Alumni in the fields of curriculum development, training and research for sustainable social development and changing needs of society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO):

The following Programme Educational Objectives are designed based on the department mission. The Certificate/ Diploma holders of Instrumentation and Control Engineering should be able to demonstrate

- 1. skill in professional / academic career using the knowledge of basic engineering principles.
- 2. ability in solving real life problems related to electrical; engineering.
- 3. sustained learning and adaptation to modern engineering tools, techniques and practices through instruction, group activity and self-study
- 4. team work while working with diverse multidisciplinary / interdisciplinary groups.
- 5. professional ethics and commitment organizational goals

PROGRAMME OUTCOMES (PO):

Instrumentation and Control Engineering Certificate/ Diploma holders of the SantLongowal Institute of Engineering & Technology, Deemed University, Longowal will have ability to:

- 1. Apply knowledge of basic engineering principles to solve Instrumentation and Control Engineering and industrial problems.
- 2. Identify and troubleshoot the real life problems using principles of mathematics, natural sciences and engineering.
- 3. Design simple solutions for Instrumentation and Control engineering problems that meet the specified needs of public health, safety, cultural, societal, environmental considerations etc.
- 4. Use scientific and technical knowledge for basic design and analysis of experiments
- 5. Select, and apply recent techniques, resources, and modern engineering and IT tools for 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 in multidisciplinary and diverse teams.
- 10. Communicate and present technical knowledge effectively in oral and written forms.
- 11. Demonstrate knowledge and understanding of project supervision
- 12. Recognize the need and prepare for lifelong learning.

SCHEME of Integrated Certificate and Diploma in Instrumentation and Control

	DE	PARTMENT OF ELECTRICAL AND INSTRUMEN	TATION	ENGI	NEERING	ì	
		THREE YEAR INTEGRATED CERTIFICATE DIP	LOMA P	ROGR	AM		
C	CERTIFICATE	IN INSTRUMENT MECHANIC, DIPLOMA IN INS	STRUME	NTAT		CONT	ROL
		ENGINEERING					
		Semester-I (ICD)	1	1	1		
S.No	Sub Code	Subject Name	L	Т	Р	Hrs.	Credits
1	AM-111	Mathematics- I	4	1	0	5	5
2	PH-111	Physics-I	4	0	2	6	5
3	CY-111	Chemistry-I	4	0	2	6	5
4	HU-111	Communication Skills-I	2	0	0	2	2
5	IE-111	Workshop Practice-I(department specific)/ Departmental course	0	0	2	2	1
6	EE-111	Basic Electrical Engineering	3	0	2	5	4
7	ME-111	Engineering Drawing	0	0	4	4	2
		Total	17	1	12	30	24
		Semester-II (ICD)	1	1	1	1	
S.No	Sub Code	Subject Name	L	Т	Р	Hrs.	Credits
1	AM-121	Mathematics- II	4	1	0	5	5
2	PH-121	Physics-II	4	0	2	6	5
3	CY-121	Chemistry-II	4	0	2	6	5
4	HU-121	Communication Skills-II	1	0	2	3	2
5	WS-122	Workshop Practice	0	0	3	3	2
6	CS-121	Computer Fundamentals	3	0	2	5	4
7	IE-121	Measurement Science	3	0	0	3	3
		Total	19	1	11	31	26
Semester-III A (ICD)							
	TP-201	Two Weeks Practical Training during			5	80	S/US
		Semester-III B (ICD)					
S No	Sub Code	Subject Name		т	D	Hrc	Crodits
1		Subject Name		0	г 2	5	
2	15 212	Sonsors and Transducors	2	0	2	5	4
2	IE 212	Hydraulic and Proumatic Instruments	2	0	2	5	4
3	15 214	Electrical and Instrumentation Drawings	3	0	2	J 4	+
4	16 215	Electromagnotic Energy Conversion	2	0	4	4	2
5	EC 211	Euclide Electronics Engineering	2	0	2	5	4
7	EC-211 MC 211	Moral values and Professional othics	5	0	2	3	4
/	1010-211		16	0	14	20	0
		Formattar IV (ICD)	10	0	14	50	22
S No.	Sub Codo	Subject Name		т	D	Urc	Cradita
3.100		Applied Mathematics	2	1	Р 0	піз.	
2 2	IE_221	Human Physiology and Modical	3	1	0	4	4
2 ×	10-221	Instruments	5		0	5	5
3	IE-222	Maintenance and Troubleshooting of	0	0	3	3	1
		Instruments	-		-		
4	IE-223	Process Control	3	0	2	5	4
5	IE-224	Analog and Digital Electronics	3	0	4	7	5
6	IE-225	Mechanical Measurements-I	3	0	0	3	3

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, ,			, ,

7	IE-226	Electronic Measurements	3	0	2	5	4		
		Total	18	1	11	30	24		
	Semester-V A (ICD)								
	TP301	1 Four Weeks Industrial Training during 10							
		summer vacations							
	1	Semester-VB (ICD)							
S.No	Sub Code	Subject Name	L	Т	P	Hrs.	Credits		
1	MC-311	Environmental Studies	2	0	0	2	2		
2	HU311	Entrepreneurship	2	0	0	2	2		
3	IE-311	Control Engineering	3	0	2	5	4		
4	IE-312	Analytical & Biomedical Instrumentation	3	0	2	5	4		
5	IE-313	Data Acquisition Systems	3	0	2	5	4		
6	IE-314	Mechanical Measurements-II	3	0	2	5	4		
7	IE-315	Microprocessor and Microcontroller	3	0	2	5	4		
8	TP-301E	Industrial Training (Evaluation only)					S/US		
		Total	19	0	10	29	24		
		Semester-VI (ICD)							
S.No	Sub Code	Subject Name	L	Т	Р	Hrs.	Credits		
1	IE-321	Elements of Computer Programming	2	0	2	4	3		
2	IE-322	Case Studies of Process Plants	3	0	2	5	4		
3	ME-326	Fundamental of Mechanical Engineering	3	0	0	3	3		
4	IE-323	Industrial Automation and Safety	3	0	2	5	4		
5	IE-324	Power Electronics and Drives	3	0	2	5	4		
6	IE-325	Telemetry and Display Devices	2	0	0	2	2		
7	IE-326	Project	0	0	4	4	2		
		Total	16	0	12	28	22		
L	l	1		- 1	1	1	1		
	Note:	Credits for certificate programme					96		

Credits for ICD programme	
Maximum courses in one semester	7
Maximum Contact Hrs.	32
Maximum Contact Hrs.	32

Course Assessment methods:

DIRECT	INDIRECT
1. Internal Test I	Course End Survey
2. Internal Test II	
3. Quiz	
4. Assignment/Tutorials	
5. Seminar	
6. End Semester Exam	

Direct Assessment Method:

Evaluation of Courses with Theory Components

- a. Continuous Assessment Examinations (CAE) carrying 50% weightage.
 - i. Two minors carry 40% weightage. Average marks of two minors is taken. Under extraordinary circumstances, a faculty may take third minor of a particular student.
 - ii. Qizzes/ Surprise tests carry 10% weightage. At least two multiple choice questions (MCQ) type quizzes of 15 minutes or assignments/tutorials or seminar per semester are required to check his/her involvement in the course.
- b. End Term Examination (ETE) carrying 50% weightage.

The structure of the question paper shall be as under: -

- i. The question paper shall have three sections and students to attempt five questions which carry equal marks, with weightage shall be given to the numerical type problems, wherever possible.
- ii. Section-I will have one compulsory question of short answer type questions covering whole syllabus. Section-II and Section-III shall contain three questions covering the entire course syllabus and the students need to attempt two questions from each section.

It is mandatory to secure 30% marks from theory component by the student.

Evaluation of Courses with Practical component

- a. Continuous Assessment Examinations (CAE) carrying 60% weightage.
 - i. Continuous assessment in Laboratory/ Practical works (Experiment performance and quizzes etc) caries 40% weightage
 - ii. Regularity/ attendance caries 10% weightage.
 - iii. Laboratory record caries 10% weightage.
- b. End Term Examination (ETE) carrying 40% weightage.
 - i. Laboratory Experiment/ Procedure writing/ Tabulation/ Equation as applicable carries 30% weightage.
 - ii. Viva voce examination/ Laboratory quiz carries 10% weightage

It is mandatory to secure 30% marks from Practical component by the student.

Evaluation of Courses with Theory and Practical Components.

Procedure for evaluation of theory component and practical components is same as detailed above.

- a. Theory component has 75% weightage
- b. Practical Component has 25% weightage.
- c. It is mandatory to secure 30% marks each from Theory and Practical component by the student.
- d. In case student fails to secure minimum qualifying marks in any component, E grade will be awarded.

SYLLABUS of Integrated Certificate and Diploma in Instrumentation and Control

IE-111 Instrumentation Workshop Practice

L	Т	Р	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Understand the use of various hand tools for manufacturing and testing

CO2: Familiarization and practice of measuring instruments for testing and measurement

CO3: Use of various chemicals used in instrumentation workshop and their safety precautions

CO4: Learn the fabrication techniques of Printed circuit board (PCB)

Pre-requisite Knowledge: Nil

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

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

Theory:

- 1. Use of Various hand tools for manufacturing and testing e.g. pliers, cutter, crimpers, stripper, screw driver etc.
- 2. Familiarization, use and practice of measuring instruments for testing and measurement e.g. Analog and Digital Multimeters, Cathode Ray Oscilloscope (CRO), frequency meter, signal generators, signal sources, LCR meter and Integrated Circuit (IC) tester.
- 3. Use of various chemicals used in instrumentation workshop and safety precautions to be observed.
- 4. Demonstration of various steps of Printed circuit board (PCB) fabrication techniques:
 - a) Identification of PCB board materials, their characteristics, corrosion and its prevention
 - b) Photo processing including photo print, etching, buffing, printing, high speed drilling, surface treatment, plated through holes, double sided PCBs.
 - c) Assembly of circuits on PCB, soldering and de-soldering techniques, wire shaping, edge connectors.

Recommended Books-

- 1. KS Jamwal, Maintenance of ElectronicEquipment, DhanpatRai and Sons
- 2. RS Khandpur, Modern Electronic Equipment, Tata McGraw Hill

EE-113 Basic Electrical Engineering

L	Τ	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

- CO1: Apply the knowledge of Electrical Engineering principles to solve D.C and A.C. circuits.
- CO2: Formulate and analyse 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 and installation of safety devices as per norms of engineering practice.

Pre-requisite knowledge: NIL

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

Unit	Main Topics Course Outlines	Hour(s)					
	Basic ConceptsElectric Charge, Current and Electromotive force, Potential and Potential Difference; conductor, semiconductor insulator and dielectric; Electrical Power and Energy; Ohm's Law, Resistance, and colour 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						
Unit-1	AC Fundamentals Concept of Alternating Voltage and Alternating Current, Difference between AC and DC, Various Terms Related with AC Waves; root mean square (RMS) and Average Values, Concept of Phase and Phase Difference, Single Phase and Three Phase Supply; three phase Star-Delta connections, Inter-Relation between phase voltage/current and line voltage/current; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit.	08					
	Measuring Instruments	03					

	Principle and Construction 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.	
	Electrical Safety	04
	Electrical Shock and Precautions against it, Treatment of Electric Shock; Concept of Fuses and Their Classification, Selection and Application; Concept of Earthing and Various Types of Earthing, miniature circuit breakers(MCBs), Earth-leakage circuit breakers(ELCBs) and their Application.	
	Electromagnetic Induction	04
	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 circuits;	
	Electrical Machines and Transformers	10
Jnit-2	Elementary concepts of an electrical machine, Basic principle of a motor and a generator, Torque due to interaction of two magnetic fields and the concept of torque angle, Common features of rotating electrical machines, Classification of Electrical machines; Principles, Construction and Working of various machines; Starters: Need, Construction and Operation, Need of a transformer, classification, Principles, Construction and Working of a Transformer, Applications of Transformers;	
	Utilization of Electricity	04
	Utilization concepts of Electricity for electrolysis process e.g., Electroplating and Electro refining, Electrometallurgy and electrotyping etc., Electrochemical Cells and Batteries; Application of Electricity for Heating, Ventilating and air-conditioning, Melting and other Metallurgical processes, Welding and illumination.	
	Basic Trouble shooting	04
	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.	

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

List of Practicals: EE-113

- 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'scurrent law (KCL) and Kirchoff'svoltage law (KVL).
- 4. Verification of equivalent resistances in series and parallel connections.
- 5. Measurement of various characteristic values of a Sinusoidal waveform with the help of CRO.
- 6. Measurement of voltage, current and power in RL and RLC circuits and verification of phase angle and power factor concept.
- 7. Study of various types of Earthings.
- 8. Study of various types of protection devices e.g. fuses, MCBs and ELCBs
- 9. Verification of Faraday's laws and Lenz's law.

- 10. Study of various types of DC motors and their starters.
- 11. Study of various types of AC motors and their starters.
- 12. Study of various types of transformers and Verification of turn's ratio.
- 13. Starting and reversing various AC and DC motors.
- 14. Fault diagnosis and removal in general electrical connection /apparatus.

IE-121 Measurement Science

L	Т	Р	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Understand the basic concept of measurement and generalized measurement system.

CO2: Acquire knowledge of the static and dynamic characteristics of measuring instruments

CO3: Know about Measurement error and statistical analysis

CO4: Learn the various units and standards of measurement and their classification

CO5: Understand different types of Signals and noise in measurement systems

Pre-requisite Knowledge: Nil

CO/PC	CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):											
COa					Progr	amme O	utcomes	(POs)				
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				М							
CO2	М											
CO3	М				М	W						W
CO4	W											М
CO5		М								W		

Unit	Main Topics and Course Outlines	Hour(s)
	Introduction	08
	Introduction to measurements, classification of the methods of measurement, types of instruments, elements of a generalized measurement system, input/output configuration of measurement systems.	
	Static Characteristics of the instruments	08
Unit-1	Measurement system performance, static characteristics in detail, error in measurement, loading effects, input/ output impedance, loading effects due to series and shunt connected instruments.	
	Dynamic characteristics of the instruments	08
	Dynamic response and analysis, mathematical models of the measurement system, zero, first and second order measurement systems, dynamic response to standard inputs,	
t-2	Measurement error and statistical analysis	08
Uni	Introduction, Limiting errors, classification of errors, Limiting errors, combination of	

quantities with errors, types of errors, statistical analysis of data- average, dispersion	
and Gaussian distribution curve.	
Unite Dimensions and standards	08
Units, Dimensions and standards	08
Units, Dimensions, systems of electrical units, dimensions in electromagnetic and	
electrostatic systems, Determination of absolute units, standards of measurement and	
their classification.	
Signals and noise in measurement systems	08
Introduction, deterministic and random signals, statistical representation of the random	
signals, effects of noise and interference on the measurement system, noise sources ,	
method of reducing effects.	

- 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

IE-211 Electrical Measurements

L	Τ	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Acquire knowledge of the fundamentals of analog instruments and their classification.

CO2: Able to understand the types of instruments and their pros and cons.

CO3: Be conversant in construction, working of measuring instruments and their proficient use.

CO4: Acquire knowledge various methods of electrical parameters measurement.

CO5: Able to handle various instruments for the measurement of electrical quantities.

Pre-requisite knowledge: Physics XII Class standard

CO/PC	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	M											S	
CO3	S												
CO4	S											W	
CO5		S										М	

Unit	Main Topics and Course Outlines	Hour(s)
	Analog instruments	08
	Analog instruments, classification of analog instruments, Principles of operations, operating forces, constructional details, control systems, damping systems, Symbols used for analog instruments.	
	Analog voltmeter, ammeter and ohmmeter	08
Unit-1	Types of instruments, PMMC instruments, shunts and multipliers, ohmmeters-series and shunt type, torque equation moving iron instruments, torque equations, Advantages, disadvantages and their comparison.	
	Measurement of power and energy	08
	Electrodynamometer type of instruments, Power in ac and dc circuits, single phase wattmeter, measurement of power in single and three phase circuits. Energy meter for ac circuits, single phase induction type watt hour meter.	
	Measurement of phase and frequency	06
iit-2	Single phase electrodynamometer and moving iron power factor meters, Frequency meters and their types, phase sequence indicators.	
Un	Measurement of resistance	08
	Classification of resistances, measurement of medium resistance with voltmeter- ammeter method, Wheatstone bridge and substitution method, measurement of low	

resistance with the Kelvin double bridge, Potentiometer method, Measurement of high	
resistance with the direct deflection method, Loss of charge method and megger.	
AC Bridges	08
General form of ac bridge, Measurement of inductance , capacitance and frequency, Maxwell bridge, Hay bridge, De-Sauty bridge, Schering bridge etc., sources of error and their minimization	

- 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.

List of Practicals: IE-211

- 1. Use of multimeter for measuring voltage, current and resistance.
- 2. To calibrate 1-phase energy meter by direct loading method.
- 3. To measure the value of earth resistance.
- 4. To measure power, power factor in a 1-phase circuit, using wattmeter and power factor meter and verify results with calculations.
- 5. Measurement of power and power factor of a three-phase balance load by 2-wattmeter method.
- 6. Measurement of voltage, frequency of a Sinusoidal signal with CRO.
- 7. Measurement of power in a 3-phase circuit using current Transformer (CT), Potential transformer (PT) and 3 phase energy meter.
- 8. Connecting appropriate instruments at the supply of an installation to measure supply voltage, frequency, power, maximum demand, Phase sequence, energy consumed.
- 9. Use of LCR meter for measuring inductance, capacitance and resistance.
- 10. Connection of 3-phase energy meter in an electrical system for Measurement of energy.
- 11. To determine the input impedance of a multimerter.
- 12. To determine the error in Measurement in voltage when a multimeter is used and then Digital voltmeter (DVM) (Vacuum Tube Volt Meter (VTVM)) is used.

IE-212 Sensors and Transducers

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Understand the basic working of various types of sensors and transducers.

CO2:Differentiate sensors and transducers.

CO3:Identify different types of sensors and their use for different applications.

CO4:Identify different types of sensors and their use for different applications.

Pre-requisite 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		M				W					M
CO2		S		M			M					
CO3		S	S	S	М	S	М					
CO4		S	S	S	М	S	М					

Unit	Main Topics and Course Outlines	Hour(s)					
Unit-1	Introductions Definitions and types of transducers, Characteristics and Choice Of Transducers, Factors Influencing The Choice of Transducers	03					
	Resistive Transducers Construction, working principles, types, applications, advantages and disadvantages of potentiometers and strain gauge, , Resistive temperature transducers(RTD), Thermocouples , Thermistors						
	Inductive Transducers Basic principles of Variable Inductance Transducers, Electromagnetic pick up, Induction potentiometer, Linear variable differential transformer (LVDT) Variable reluctance transducers.	09					
	Piezoelectric Transducers Basic principle and uses of piezoelectric transducers, Piezoelectric crystals and their properties, General forms of piezoelectric transducers						

	Capacitance 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				
	Digital Encoding Transducers					
Jnit-2	Definition, classification, construction of digital encoding transducers, optical displacement transducers, shaft encoders					
	Photo electric devices					
	Definitions and types photoemissive cells, Photovoltaic, photoconductive cells	03				
	Other Transducers					
	Load cell, strain gauge and inductive torque meter magnetostrictive transducers electrical tachometers (AC and DC both)	06				

- 1. Rangam, Sarmaand Mani, Instrumentation -Devices and Systems, TMH
- 2. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, DhanpatRai
- 3. E.O. Doeblin, Measurement Systems, McGraw Hill
- 4. Nakra, Instrument Measurement and Analysis, PHI
- 5. W.D. Cooper, A.D. Helfrick, Electronic instrumentation and measurement techniques, PHI

List of Practical: IE-212

- 1. To study the characteristics of LVDT.
- 2. To study the characteristics of Variable Capacitor.
- 3. To study the characteristics of Light dependent resistor (LDR).
- 4. To study the characteristics of Strain Gauge.
- 5. To study the characteristics of Crompton Potentiometer.
- 6. To study the characteristics of RTD.
- 7. To study the characteristics of Thermistor.
- 8. To study the characteristics of Thermocouple.

IE-213 Hydraulic and Pneumatic Instruments

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Understand the fundamental of fluid power system

CO2: Learn the basic of hydraulic system and working of hydraulic components

CO3: Design hydraulic circuit

CO4: Learn the basic of pneumatic system and working of hydraulic components

CO5: Design of the pneumatic circuit

Pre-requisite Knowledge: Nil

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

	5.	
Unit	Main Topics and Course Outlines	Hour(s)
	Fluid Power Systems and Fundamentals Introduction to fluid power, Advantages of fluid power, Application of fluid power systems, Properties of hydraulic fluids, General types of fluids, Fluid power symbols, Basics of Hydraulics, Application of Pascal laws- Laminar and turbulent flow, Reynolds Number, Darcy equation, Losses in pipe, valves and fittings	04
Unit-1	Hydraulic System and Components Sources of hydraulic power, Pumping theory, Pump classification, Gear pump, vane pump, piston pump, construction and working of pumps, pump performance, variable displacement pumps, Fluid power actuators, Linear hydraulic actuators, Types of hydraulic cylinders: single acting, double acting, special cylinders like tanden, rodless, telescopic, cushioning mechanism, construction of double acting cylinder, Rotatory actuators, fluid motors, gear, vane and piston motors	10
	Design of Hydraulic Circuits Construction of control components, directional control valve: 3/2 valve, 4/2 valve, shuttle valve, check valve, pressure control valve, pressure reducing valve, sequence	10

	valve, flow control valves ,fixed and adjustable, electrical control solenoid valve,	
	relays, ladder diagram, accumulators and intensifiers	
	Pneumatic Systems and Components	
-2	Pneumatic Components, Properties of air, compressors, filter, regulator, lubricant unit, air control valves, quick exhaust valves, pneumatic actuators, fluid power circuit design, pneumo-hydraulic circuits, sequential circuits for simple applications	12
Unit	Design of Pneumatic Circuits Servo systems, hydro mechanical servo systems and proportional valves, Fluidics: Introduction to fluidic devices, simple circuits, Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams,	12

- 1. Andrew Parr, *Hydraulics and Pneumatics: A technician's and engineer's guide*, 3rdedition, Butterworth-Heinemann, 2011.
- 2. Harry L.Stewart, *Practical Guide to Fluid Power*, 2nd edition, Audel, 1968.
- 3. K. ShanmugaSundaram, *Hydraulic And Pneumatic Controls (Understanding Made Easy)*, S.Chand, 2006
- 4. R. Srinivasan, *Pneumatic and Hydraulic control*, McGraw Hill Education, 2008.
- 5. S.R. Majumdar, Pneumatic Systems: Principles and maintenance, Tata Mcgraw Hill

List of Practical's: IE-213

- 1. Familiarization with pneumatic system's various parts such as compressor, regulator and lubricator.
- 2. To study 3/2 value and 5/2 value.
- 3. To study single acting and doubling acting cylinder and Flow restriction valve.
- 4. To study the Pneumatic Logic Circuit.
- 5. To study the use of Pneumatic Limit Switch.
- 6. To study the Hydraulic Trainer Kit.
- 7. To study the use of Hydraulic valve.
- 8. To study hydraulic system using single acting and double acting cylinder.
- 9. To study the practical application of Hydraulic system in stamping device.

IE-214Electrical and Instrumentation Drawing

L	Т	Р	Credits	Weekly Load
0	0	4	2	4

Course Outcomes:

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

CO1: Understand the fundamental concepts of electrical and Instrumentation Drawings.

CO2:Develop the complete knowledge of rules involved in drawing the various layouts from scaling upto the complete electrical installations and electrical wiring.

CO3:Identify and understand different Process flow diagrams.

CO4:Formulate and solve the engineering problems of different Process flow diagrams.

CO5:Identify different pneumatic and hydraulic components.

Pre-requisite Knowledge:

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

Unit	Main Topics and Course Outlines	Hour(s)					
	Piping and Instrument Drawings and Instrument symbols	08					
	General rules to be followed in drawing a flow sheets and symbols in a typical process industry						
	Meanings of functional instrumentation-identification letters						
	Relay function symbols						
_	Interlock logic symbols						
it.	Graphic symbols						
n n	Process Flow diagrams(PFD)	06					
	PFDs of processes like power plant, fertilizer plants, cement plants etc.						
	Binary logic diagrams	06					
	Symbols, flow diagrams, logic diagrams						
t-2	Electrical drawings	08					
Uni	Electrical symbols, ground symbols, resistor, inductive and capacitor symbols, meter						

Panel wiring diagrams	04
Symbols and wiring diagrams	
Pneumatic and hydraulic diagrams	08
Basic symbols, pumps and compressor, motors, cylinders, control valves, control	
nethods, check valves, exhaust valves etc.	

1. Liptak, Instrument Handbook, Vol.2

2. Dr.S.K.Bhattacharya, Electrical Engineering Drawing

IE-215Electromagnetic Energy Conversion

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Know the basic concept of electro-magnetic conversion device

CO2: Understand the construction and working principle of transformers and DC Machine

CO3: Understand the working principle of Synchronous Machine and its characteristics

CO4: Learn the working principle of Induction Machine and comparison with Synchronous Machine

Pre-requisite Knowledge: EE-113, Basic Electrical Engineering

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

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

Unit	Main Topics and Course Outlines	Hour(s)
	INTRODUCTION Basic Principle, Types and constructional features of electrical machines, torque, torque angle, basic electromagnetic laws, Induced EMF. Review of electromagnetism, Magnetic field strength, Magnetic force. Energy stored in electric and magnetic fields, energy conversion in singly and multiple excited systems, reluctance torque, reluctance and hysteresis motors.	08
Unit-1	MAGNETIC CIRCUITS Magneto motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, magnetic leakage and fringing, hysteresis and eddy current losses. Faraday's laws, Lenz's law, statically and dynamically induced electromotive force (E.M.F)., Energy stored in magnetic field.	08
	TRANSFORMERS Introduction, Principle of working, construction of single phase transformer, EMF equation, phasor diagram on no-load, leakage reactance, transformer on load, equivalent circuit, voltage regulation, power and energy efficiency, open circuit and short circuit tests, equivalent circuit parameters estimation. Effect of saturation on exciting current, in-rush current phenomenon. Parallel operation of single phase	08

	transformer.	
	D.C. MACHINE Construction of D.C. machines – theory of operation of D.C. generator – characteristics of D.C. generators – armature reaction – commutation – principle of operation of D.C. motor – voltage equation – type of D.C. motor and their characteristics – speed control of D.C. motors.	10
Unit-2	SYNCHRONOUS MACHINE Principle of alternators – construction details – equation of induced EMF – vector diagram – method of starting of synchronous motor – torque developed by the motor – V curves – speed control.	08
	INDUCTION MACHINES Construction and principle of operation – classification of induction motor – relation between torque and rotor power factor – starting and running condition – condition for maximum torque – comparison between synchronous motor and induction motors – speed control of induction motors.	06

- 1. B. L. Theraja, *Electrical technology*, Vol I to II, S. Chand and Co., New Delhi
- 2. D P Kothari and I J Nagrath, Electrical Machine, TMH
- 3. Edward Hugh, *Electrical Technology*, Pearson Education.
- 4. M.G. Say, *Performance design and Testing of A.C. Machines*, 3rd edition, CBS Publisher, 2002.
- 5. MIT Department of Electrical Engineering, Magnetic Circuits and Transformers: A First Course for Power and Communication Engineers Magnetic Circuits and Transformers, MIT Press, 1977.

List of Practical: IE-215

- 1. Measurement of active and reactive power and phase-shift in AC circuits.
- 2. Series and parallel resonant circuits.
- 3. Measurement of time constants (RC/RL)
- 4. Verification of Network theorems (Superposition, Thevenin, Maximum power transfer)
- 5. Predetermination of efficiency and regulation of single-phase transformers
- 6. Load test on single phase/three phase transformers
- 7. Load characteristics of DC motors (shunt, series and compound)
- 8. Load characteristics of DC shunt/compound generators.
- 9. Load test on alternators
- 10. Synchronous motor characteristics
- 11. Load test on three phase induction motors
- 12. Load characteristics of a single phase induction motors.
- 13. House wiring and earthing.
- 14. Speed control of DC shunt motor using (a) armature control (b) field control
- 15. Swinburne's test

IE-221 Human Physiology and Medical Instruments

L	Т	Р	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Acquire the basic knowledge of human body and blood compositions

CO2: Learn the working of Cardiovascular and Respiratory system of Human Body

CO3: Learn basic understanding of Human nervous system

CO4: Understand and interpret the electro-potential signals

CO5: Learn the Biomedical Telemetry and Patient Safety systems

Pre-requisite Knowledge: Biology XI and XII

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

Unit	Main Topics and Course Outlines	Hour(s)					
	Introduction	04					
	Human body, cells, Tissues, blood compositions, blood group red blood cell (RBC), white blood cell (WBC), Deoxyribonucleic Acid (DNA), GENES.						
	Cardiovascular and Respiratory system	12					
Unit-1	Introduction to Cardiovascular system, heart structure, electrocardiogram, flow of blood through heart, blood pressure. Lungs, types of respiration, measurement of respiration rate, ventilation, gas exchange, mechanism in lungs, lung volume capacities.						
	Nervous system	08					
	Anatomy of nervous system, neurons, neural communication, brain, spinal cord.						
5	Introduction to Electrocardiography(ECG), Electroencephalography (EEG),	08					
nit	electromyogram (EMG): Physiological electrodes and transducers, origin of						
U	bioelectric signals; electrodes for ECG, EEG, EMG, skin contact Impedance, conducting of electrode jellies and creams, electrocardiogram, electroencephalogram						

and electromyogram	
Patient Monitory Systems	08
System concept; measurement of blood pressure, temperature, Pulse, respiration rate, ambulatory monitoring instruments, Application of computers in patient monitoring system, use of computers for processing cardio-topographic data.	
Biomedical Telemetry and Patient Safety	08
Concept of Telemetry, Advantages of Telemetry, Wireless Telemetry, single channel; analog physiological signals over telephone lines, Patient Safety: Electric	

Text Book

- 1. A.K Jain, Human Physiology, Arya Book Depot.
- 2. L Cromwell, Biomedical instrumentation and measurement, 2nd edition, Prentice Hall (India), 1990
- 3. RS Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003.

Reference Books

- 1. Geddes and Baker, Principles of Applied Biomedical Instrumentation, Wiley.
- 2. N J Chinoi, Biomedical (for class XI and XII), NCERT.
- 3. Peter Strong, Physiological measurement, Prentice Hall.
- 4. Waugh and Grant, Anatomy and Physiology, Elsevier.

IE-222Maintenance and troubleshooting of Instruments

L	Т	Р	Credits	Weekly Load
0	0	3	1	3

Course Outcomes:

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

CO1: Familiarize with basic tools and chemicals used for testing instruments.

CO2:Identify different PCB fabrication materials and instruments and know the fabrication technique.

CO3:Apply their fabrication knowledge for different applications.

CO4:Understand some sophisticated instruments and their testing and troubleshooting.

Pre-requisite Knowledge:

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

					D	0							
COs		Programme Outcomes (POS)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
			_		-				_	-			
CO1													
CO2		S		W									
CO3			S	M			M						
CO4						Μ							

List of Practicals: IE-222

- 1. Use of Various hand tools for manufacturing and testing e.g. pliers, cutter, crimpers, stripper, screw driver etc.
- 2. Familiarization, use and practice of measuring instruments for testing and measurement e.g. Analog and Digital Multimeters, CRO, frequency meter, signal generators, signal sources, Inductance-Capacitance-Resistance (LCR) meter and IC tester.
- 3. Use of various chemicals used in instrumentation workshop and safety precautions to be observed.
- 4. Demonstration of various steps of printed circuit board (PCB) fabrication techniques:
 - (i) Identification of PCB board materials, their characteristics, corrosion and its prevention(ii) Photo processing including photo print, etching, buffing, printing, high speed drilling, surface treatment, plated through holes, double sided PCBs.

(iii) Assembly of circuits on PCB, soldering and de-soldering techniques, wire shaping, edge connectors.

- 5. Servicing and troubleshooting of Electrocardiography(ECG) equipment
- 6. Servicing and troubleshooting of Electroencephalography(EEG) equipment
- 7. Servicing and troubleshooting of electromyogram (EMG) equipment
- 8. Study of spirometers.
- 9. Testing Procedures of Resistance inductance and capacitors.

Recommended Books-

- 1. RS Khandpur, Modern Electronic Equipment, Tata McGraw Hill
- 2. KS Jamwal, Maintenance of Electronic Equipment, DhanpatRai and Sons
- 3. RS Khandpur, Handbook of Biomedical Instrumentation, Tata Mcgraw Hill.

IE-223Process Control

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Understand the basic knowledge of the components used in process industries.

CO 2: Identify different controller modes and their applications in different fields.

CO 3: Relate and compare different types of control schemes.

CO 4: Discuss different types of control valves used for different processes.

Pre-requisite Knowledge:

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

Incor	·	
Unit	Main Topics and Course Outlines	Hour(s)
	Basic Control Loops and Characteristics	12
	Introduction, resistance (R), inductance (L), capacitance (C) elements in pneumatic,	
	hydraulic and electrical system; Simple Processes like: Single capacity pressure	
	system, Single capacity temperature system, Single capacity level system, Single	
	flow loop system, Computer control systems - Introduction to Supervisory digital	
	control (SDC) and direct digital control (DDC) and their applications in process	
	industries.	
-		
Jnit-	Basic Controller Modes and Characteristics	12
	Study of process characteristics; controller operating models, on-off, proportional,	
	integral, derivative, proportional-integral, proportional-derivative, proportional-	
	integral-derivative; relative merits of the above control modes; suitability of various	
	control actions for different application	
	Multi-loop Controls	12
	Ratio, cascade, feed-forward control, Feedback Control, Various types of controllers	
	- pneumatic, hydraulic, electronic, electro-hydraulic, digital. Study of transmitters-	

	pneumatic, electronic, signal converters.	
	Annunciators	06
t-2	Annunciators, Concept of sequencing, annunciation and interlocking applicable to process control systems.	
Uni	Control valves	06
	Globe, Ball, Gate, Needle, Diaphragm, Butterfly, Single seated and double seated valves, Selection criteria for control valves	

Text Book

- 1. EcKman DP, Automatic Process Control, TMH
- 2. SurekhaBhanot, *Process Control, Principle and applications*, OXFORD **Reference Books**
- 3. Johnson Curtis, Process Control Instrumentation Technology, Prentice Hall
- 4. Eckman, Donal P, Principles of Industrial Process Control, John Wiley
- 5. Harrist P, Process Control, Prentice Hall
- 6. Liptak, Instrument Engineers Handbook, Wiley

List of Practicals: IE-223

- Study of Pneumatic trainer kit (PTK) and demonstration of all components fabricated on kit.
 (a) Study of and gate and or gate on Pneumatic trainer kit
 - (b) Study of single acting cylinder and double acting cylinder using 3/2 way valve and solenoid valve on PTK.
- 2. (a) Study of Hydraulic Trainer kit (HTK)
 - (b) Study of single acting cylinder and double acting cylinder using hydraulic trainer
- 3. To study the calibration of the Electronic proportional-integral-derivative PID Controller.
- 4. To study the calibration of input/output (I/P) (Current to Pneumatic) converter
- 5. To study the calibration of Differential Pressure Transmitter
- 6. Study of Control Valve characteristics.
- 7. To study the tank level control loop (proportional-integral (PI) control)
- 8. To study the pressure control loop on Process Simulation kit
- 9. Study of feedback flow control loop.
- 10.Study of pressure transmitter.
- 11. Study of feedback temperature control system using proportional-integral (PI) controller.
- 12. Study of feedback temperature control system using proportional (P) controller.
- 13.Study of feedback temperature control system using proportional-integral-derivative (PID) controller.
- 14.Study of feedback temperature control system using PD controller

IE-224 Analog and Digital Electronics

L	Т	Р	Credits	Weekly Load
3	0	4	5	7

Course Outcomes:

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

- CO1: Understand the advantage of integrated circuit (IC) and learn classification of fabrication techniques
- CO2: Learn the working of operational amplifier (Op-amp), 555 timer and their applications.
- **CO3:** Learn the number system theory and various logic gate circuits
- CO4: Acquire knowledge of various Sequential Logic Concepts
- CO5: Understand the working and applications of various Registers and Counters circuits

Pre-requisite Knowledge: Nil

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	М													
CO2		S					М							
CO3					W									
CO4	М						M							
CO5	М				М		W							

Unit	Main Topics and Course Outlines	Hour(s)
	Introduction Definition, Advantages of integrated circuits (ICs) over discrete components, Integration Types – small scale integration (SSI), medium scale integration(MSI), large scale integration(LSI), Classification- Monolithic and hybrid, Monolithic techniques, Monolithic components.	04
Unit-1	Operational Amplifier (Op-amp) Characteristics Ideal, inverting, non-inverting inputs virtual ground, Applications, Inverting, non-inverting amplifier	08
	Op-amp Applications Comparator, Inverter, Adder, Subtractor, differentiator, integrator.	08
	555 timer	04

	Simple Block Diagram, Pin configuration, 555 as a Mono stable and astable Multi- vibrator.	
	Number Systems and Boolean Algebra Number Systems And Boolean Algebra, Radix conversion, Subtraction using 1's and 2's complements, Binary codes, Canonical forms.	06
t-2	Combinational Logic Logic Gates, Definition and symbol, truth table and waveforms of NOT, AND, OR, NAND, NOR, XOR and XNOR, Universal Logic gates, Simplification using Karnaugh map.	08
Unit	Sequential Logic Concepts Flip flops: SR, JK, D and T flip-flops - Level triggering and edge triggering, Excitation tables	06
	Registers and Counters Introduction and basic concepts including shift left and shift right, Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out. Asynchronous and Synchronous Counters. Up Down Counter and Ripple Counter.	08

- 1. Anand Kumar, Fundamentals of Digital Circuits, 3rd Edition, Prentice Hall of India, 2014.
- 2. Albert Paul Malvino, Principles of DigitalElectronics, 8th Edition, Tata McGraw Hill, 2015.
- 3. Gayakwad, A. Ramakant, Op-Amps and Linear Integrated Circuits. PHI Learning, 2009.
- 4. Morris Mano, *Digital Logic and Computer Design*, 2nd Edition, Prentice Hall of India, 1991.
- 5. Ronald J. Tocci, Neal S. Widmer and Moss L. Gregor, *Digital Systems: Principles and Applications*, 11th Edition, Prentice Hall of India, 2010.

List of Practicals: IE-224

- 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 op-amp as integrator.
- 4. To demonstrate working of an op-amp as adder.
- 5. To demonstrate working of an op-amp as a subtractor.
- 6. To demonstrate working of an op-amp as a low pass filter.
- 7. Verification of the truth tables of transistor-transistor logic (TTL) gates.
- 8. Verify the NAND and NOR gates as universal logic gates.
- 9. Design and verification of the truth tables of Half and Full adder circuits.
- 10. Design and verification of the truth tables of Half and Full subtractor circuits.
- 11. Verify the truth table of a J-K flip-flop.
- 12. Design of 4 bit shift register

IE-225Mechanical Measurements-I

L	Т	Р	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Acquire the basic knowledge about the pressure, level and flow measurement principles.

CO 2: Identify different instruments used for the measurement of the different parameters.

CO 3: Classify the instruments for different applications and understand their working.

CO 4:.Differentiate the studied techniques for different applications.

Pre-requisite Knowledge:

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

					Progr	amme O	utcomes	(POs)				
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S										
CO3		S	М		W	W						
CO4		М	М		W							

Unit	Main Topics and Course Outlines	Hour(s)					
	Pressure mesurements	12					
	Defining Concept of atmospheric, absolute, vacuum, and gauge pressure; Units of pressure						
	Manometers: Principle; types						
Unit-1	Elastic type:Bourdon tube; types, materials, construction; Metallic Diaphragm elements, construction; Capsule type; Bellows type,						
	Electric methods of pressure measurements: Strain gauge pressure measurement, capacitance pressure measurement, potentiometric pressure measurements, resonant wire pressure measurements, piezoelectric pressure measurement, magnetic pressure measurement, optical pressure measurement, pressure switches,						
	Special Pressure Measurement Techniques: Piston type pressure measurement; Pressure sensitive wire transducer, Bulk Modulus Cell Pressure Transducer; Dead Weight Piston Gauges						
	Vacuum Measurement: Mechanical Vacuum Gauges: McLeod Vacuum Gauge, Molecular Momentum Vacuum gauge, Sinning Ball Element Type Vacuum Gauge;						
	Thermal Vacuum Gauges: Knudsen Gauge, Thermal Conductivity Gauges, Pirani (Resistance Wire) Vacuum gauge, Thermistor Vacuum gauge, Thermocouple						

Vacuum Gauge; Ionisation Vacuum Gaues – Hot Cathode Ionization Gauge, Cold Cathode Ionization Gauge, Radioactive Source Ionization Gaug	
Calibration of pressure measuring instruments	
Flow measurement	12
Types of flow; Units of flow – volumetric and mass; Importance of flow measurement	
Mechanical Flow Meters: Theory of fixed restriction variable head type flow meters: Flow of incompressible fluids in pipes; ratio; Reynolds Number; Discharge Coefficient; Flow Coefficient; Flow of compressed fluid in pipes	
Orifice Flow Meter: Principle of operation; types of orifice plates; machining methods of orifice; material for orifice; position of tapes in orifice; Orifice Plate selection and Designing	
Venturi Tubes: Classical (long form) Venturi; Short form Venturi; Types of Ventru Tubes; Installation	
Flow Nozzle: Flange type flow nozzle; Design of flow nozzle; applications	
Dall Tube: Construction and working; applications	
Installation of Head Flow Meters: Pressure pipe layout; Installation of condensation pots; Installation of sealing pots; piping arrangement practical considerations	
Pitot Tube: Principle; Averaging Pitot Tube (Annubar); Applications	
Quantity Meters: Positive Displacement Meters: Nutating Disc Type; Reciprocating Piston Type; Oval Gear Type; Helix Type; Their working principles; application; selections	
Inferential Flow Meters: Principle; Variable Area Flow Meters: Rotameters and Piston Type Meters; Construction; Target Flow Meters: principle of working; construction, applications	
Mass Flow Meters: Angular – Momentum Mass Flow Meter; Constant Torque Hysteresis Clutch Mass Flow Meter; Impeller Turbine Mass Flow Meter; Twin Turbine Mass Flow Meter; Gyroscopic Mass Flow Meter; Coriolis Mass Flow Meter; Thermal Mass Flow Meter; Volume Flow Meter plus Density Measurement (Radiation type Mass Flow Meter)	
Electrical Flow Meters:	
Electromagnetic Flow Meter: Principle; Excitation schemes (AC, DC, and Dual Frequency); Construction	
Ultrasonic Flow Meter: Principle; Types of Ultrasonic Flow Meters; Construction; Doppler Flow Meters; Applications	
Laser Doppler Anemometer Systems: Principle of operation; working; applications Other Types of Flow Meters:	

	Purge Flow Regulators: Rotameter types purge meter; applications	
	Cross Correlation Flow Meter: Principle of working; applications	
	Level Measurements	12
	Level and Volume; Relation of level and volume; Importance of level and volume measurement;	
	Level Measurement Using Gauge Glass Technique, Construction, working, Applications	
	Float Type Level Indications: Float level switch, Level measurement using float – rope method, float operated spring loaded level switch, magnetic float device, applications	
	Level Measurement Using Displacer and Torque Tube: Construction, material of construction, principle, working, applications	
	Air-purge System/Bubbler System:Principle, construction, operation, operating considerations, applications.	
	Hydrostatic Pressure Method: Principle, Hydrostatic Pressure Measurement in Open Tank, Hydrostatic Pressure Measurement in Closed Tank, Applications, Calibration	
	Differential Pressure Method for Open and Closed Tank, Use of Electronic DP	
Unit-2	Transmitter, Practical consideration, Location Correction for Hydrostatic Pressure Level Measurement, Calibration of receiving instrument Level Measurement by Electrical Methods	
	Temperature Measurement	12
	I. Concept of heat and temperature, Defining temperature Temperature scale: Centigrade, Kelvin, Fahrenheit, and Rankine, comparison of temperature scale	
	Filled: System Thermometry;	
	Metallic –Expansion Thermometers;	
	Resistance Temperature Detector (RTD): Temperature coefficient of resistivity of various metals; metals used in RTD; Platinum Resistance Thermometers; Various RTD standards: ASTM – 3711, IEC60751, BS 1904, DIN 43760, and Mil – T – 24388; RTD resistance measurement with Wheatstone Bridge Circuits: two – wire circuit, three – wire circuit, four – wire measurement circuit, RTD resistance measurement with Constant Current Source, Industrial RTD assembly, Thermowellassembly, RTD applications; Thermistors: Theory; materials; types; and applications	
	Thermocouples: Seebeck effect; Peltier effect; Thomson effect; thermoelectric diagram; thermoelectric inversion; law of intermediate metals; law of intermediate temperature; cold junction compensation; Thermocouple materials: Base Metal Thermocouple, types - E, J, K, T, and N; Precious Metal Thermocouple, types - B, R,	

 and S; thermocouple construction: plain wire thermocouple, Sheathed thermocouple, Mineral – insulated thermocouple, surface contact thermocouple, hot metal thermocouple, liquid metal thermocouple, thermopiles; thermocouple compensating cables; Thermocouple Tables (standard), use of thermocouple in various applications
 Radiation Thermometers: Theory of black body radiation; realization of black body radiation; Prevost's theory of exchange; Stefan – Boltzmann law; Wien's law (distribution of energy in spectrum); Radiation thermometer types: total radiation thermometers, thermopile used in total radiation measurement, Surface radiation thermometer; Pyroelectric techniques; applications.
 Miscellaneous Measurement Techniques:Pyroelectric cone, temperature sensitive pigments, liquid crystals, applications.

Recommended Books-

- 1. B. G. Liptak, Instrument Engineers' Handbook: Process Measurement and Analysis
- 2. E. D. Doeblin, Measurement Systems: Application and Design, McGraw Hill Publication
- 3. K. Krishnaswamy and S. Vijayachitra, *Industrial Instrumentation*, New Age International Publication

IE-226Electronic Measurements

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Understand the basic electronic instruments and their working principle.

- **CO 2:** Illustrate the different blocks of some meters and CRO.
- **CO 3:** Demonstrate the generation of different waveforms.
- **CO 4:** Analyse different types of waveforms using Signal Analyzers.

CO 5: Understand frequency measurement and their error analysis.

Pre-requisite Knowledge:

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

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

Unit	Main Topics and Course Outlines	Hour(s)
	Electronic analog meters Electronic analog meters: DC voltmeters- Loading- Transfer volt meter- Chopper type- DC amplifier voltmeter- Solid state voltmeter – Differential voltmeter – Peak responding voltmeter – True root mean square (RMS) voltmeter – Calibration of DC instrument	08
Unit-1	Digital voltmeter (DVM): Introduction – Ramp technique – Dual slope - Integrating type DVM –Successive approximations type DVM – Resolution and sensitivity of digital meters – General specifications of a DVM.	08
	Cathode Ray Oscilloscope (CRO) Introduction, CRO block diagram, cathode ray tube (CRT) circuits, observation of waveform on CRO, Measurement of voltage, current, phase and frequency.	08
Unit- 2	Instruments for generation and analysis of waveforms	08

Oscillators, classification of oscillators, Square wave and pulse generator, triangular wave shape generator, Signal generators, swept frequency generator, Frequency synthesizer.	
Signal analyzers	08
Wave analyser, harmonic distortion analyzer, spectrum analyzer, logic analyzer.	
High frequency measurement	08
Frequency measurement, period measurement, errors in measurement, universal counters and extension of the range of counters	

- 1. Golding E.W. and Wides F.C., Electrical Measuring Instruments and Measurements, Wheeler
- 2. 2.H.S. Kalsi, Electronic Instrumentation, EXCEL BOOKS
- 3. 3 Singh, Industrial Instrumentation and control, Second edition, TataMcgraw-Hill, NewDel
- 4. 4 A K Sawhney, A course in Electrical and Electronic Measurements and Instruments, Dhanpatrai
- **5.** 5 Heltrick A.D. and Cooper W.D., *Modern Electronic Instrumentation and Measuring Instruments*; Wheeler

List of Practicals: IE-226

- 1. Study of principle of operation of various types of electromechanical measuring instruments.
- 2. Measurement of resistance using Wheatstone Bridge.
- 3. Measurement of resistance using kelvin's Bridge.
- 4. Measurement of self inductance using Anderson's Bridge.
- 5. Measurement of capacitance using Schering Bridge.
- 6. Plotting of Hysteresis loop for a magnetic material using flux meter.
- 7. Measurement of frequency using Wein's Bridge.
- 8. To study the connections and use of Current and potential transformers and to find out ratio error.
- 9. Determination of frequency and phase angle using CRO.
- 10. Measurement of unknown voltage using potentiometer.
- 11. To find 'Q' of an inductance coil and verify its value using Q- meter.

IE-311 Control Engineering

L	Τ	Р	Credits	Weekly Load
3	0	2	4	5

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

CO1: Develop the theoretical aspects of Control systems and feedbacks.

CO2: Able to determine transfer function from block diagram reduction technique and mason's gain formula.

CO3: Solve the steady state and transient analysis of a system for standard inputs

CO4: Study the concept of root locus and zeros and poles to analyse the stability analysis of a system.

CO5: Understand the frequency response and to perform stability analysis in frequency domain

CO6: Present the essential knowledge to understand AC, DC servo meters

Pre-requisite Knowledge:

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

Unit	Main Topics and Course Outlines	Hour(s)
	Introduction	04
	Introduction to control system – Basic components of control systems, open loop and closed loop control system, types of feedback control systems, transfer function, transfer function of electrical, mechanical and electromechanical systems.	
•	Block diagram and Signal flow graphs	08
Jnit-1	Block diagrams of control systems, block diagram reduction, signal flow graph, Mason's gain formula, Drawing signal flow graph from given block diagram.	
	Time domain Analysis	10
	Type and order of a system, typical test signals for the time response of control system,Unit step, unit ramp and unit impulse - response of first and second order systems, time domain specifications,steady state errors.	
	Poles, Zeros and stability	06
	Introduction, concepts of stability ,absolute and relative stability, relationship of characteristic equation roots and stability, poles and zeros plots, Routh Hurwitz	

	stability criterion,	
	Root Locus technique –	06
(t-2	Root Locus technique – basic theory and properties of root loci – procedure for construction of root loci, interpretation of the root locus diagrams.	
Uni	Frequency response	10
	Frequency response, frequency domain specifications, frequency response for a first order and second order system,	
	Frequency domain analysis	08
	Frequency domain analysis techniques, Bode plot for transfer function, determination of gain margin, phase margin, ,Nyquist stability criterion.	
	Control system components	04
	Error detectors, DC and AC servo motors- Gyroscopes- Stepper motor, synchros, resolvers, Tacho-generators	

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

List of Practicals: IE-311

- 1. To study the operation of Temperature control system (Proportional controller).
- 2. To study the operation of D.C. Position Servomotor.
- 3. To study the operation of Temperature control system (Relay).
- 4. To control the Temperature of a system using P+I controller.
- 5. To control the Temperature of a system using P+I+D controller.
- 6. To study the time response of first order system.
- 7. To study the time response of second order system.
- 8. To study the operation of potentiometer error detector.
- 9. To study the A.C. servomotor and plot the torque. Vs. speed characteristics.

IE-312 Analytical and Biomedical Instrumentation

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

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

- CO1: Learn the basics of instrumentation related to biomedical systems.
- **CO2**: Able to examine how the instrument like ECG,EMG and EEG etc actually makes the measurement.
- CO3: Study the concept of imaging system.
- **CO4:** Get overall knowledge of the medical equipments for diagnosis and therapy.
- CO5: Understand the proper use and importance of measurement of monitoring instrument statistics.
- CO6: Know about basics of Electromagnetic radiation and analytical instruments

Pre-requisite Knowledge:

CO	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	S									
CO3	S	М										W			
CO4	S		S			M									
CO5	М											W			
CO6	S											W			

Introduction Fundamentals of Medical Instrumentation, Physiological electrodes and transducers, sensors for measurement of pressure, temperature, pulse, respiration, Introductions to pacemakers, defibrillators	06
	1
Bioelectric Potentials and Recorders origin and characteristics of bioelectric signals; electrodes for Electrocardiography(ECG), Electroencephalography (EEG), electromyogram (EMG), electrocardiograph, phonon-cardiograph, electroencephalograph and electro-myograph, Electrical conductivity of electrode jellies and cream	06
Imaging Techniques X-Ray and digital radiography, computed tomography (CT) scan, Magnetic resonance imaging (MRI), Ultrasonic and Thermal Imaging System	06
Prosthetic and Monitoring Instruments	10
))))) (((((((((((((((((Bioelectric Potentials and Recorders brigin and characteristics of bioelectric signals; electrodes for Electrocardiography(ECG), Electroencephalography (EEG), electromyogram (EMG), electrocardiograph, phonon-cardiograph, electroencephalograph and electro-myograph, Electrical conductivity of electrode jellies and cream Imaging Techniques X-Ray and digital radiography, computed tomography (CT) scan, Magnetic resonance imaging (MRI), Ultrasonic and Thermal Imaging System Prosthetic and Monitoring Instruments dialysis machine, ventilator, respirators, Audiometers – basic audiometer, speech

	audiometer, Measurement of heart rate, pulse rate, blood pressure, temperature and respiration rate, Oximeters, Arrhythmia and Ambulatory monitoring Instruments	
	Electromagnetic Radiation	04
	Electromagnetic Radiation And Spectrum, Interaction of Radiation With Matter,	
	Beer's Lamberts Law, Radiation Sources	
	Spectrophotometer (ultraviolet (UV), Visible and infrared (IR))	06
2	Basic principle, block diagram and related instrumentation,	
Unit-	Analytical Instruments	14
	Blood Flow-meters – Electromagnetic ultrasonic. Pulmonary function Analyzer – measurement, spirometry analysis, respiratory gas analyzer. Blood Gas analyzers – Blood pH, Oxygen, PCO2, PO2 measurement complete blood gas analyzer, cell counter.	

RECOMMENDED BOOKS:

Text Book:

1. RS Khandpur, Handbook of Biomedical Instrumentation, TMH, 2003

Reference Books:

- 1. Chromwell, *Biomedical Instrumentation*, Prentice Hall,2ND edition,2009
- 2. Geddes and Baker, Principles of Applied Biomedical Instrumentation, Wiley and sons, 1975
- 3. Peter Strong, Physiological measurement, Prentice Hall, 1970

List of Practicals: IE-312

- 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. To study the characteristics of ECG signal.
- 8. To Study the characteristics of EEG signal.
- 9. To measure the transmittance of a given sample solution using UV spectrometer.
- 10. To measure the transmittance of a given sample solution using Visible spectrometer
- 11. To measure the concentration of a given sample solution using UV spectrometer.
- 12. To measure the concentration of a given sample solution using Visible spectrometer

IE-313 Data Acquisition Systems

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

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

CO1: Study the basics of Data acquisition system

CO2:Able to examine how the instrument like ECG, EMG and EEG etc. actually makes the measurement.

CO3: Understand how data is to be transmitted through different techniques.

CO4: Get overall knowledge of converters.

CO5:Understand the proper use and importance of measurement of monitoring instrument statistics.

CO6 : Study the working principle of Data 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			
CO2		S				M									
CO3	S	S													
CO4	S											W			
CO5		S			М										
CO6		S			W										

Unit	Main Topics and Course Outline	Hour(s)						
	Introduction	08						
	General concept, Importance of data acquisition system (DAS) to instrumentation Types of DAS components of Analog data acquisition system, Digital data acquisition system, Use of data acquisition system, Use of Data Acquisition system							
-	Signal Conditioning	08						
Unit	Signal conditioning of inputs, single channel and multichannel data acquisition, computer based DAS,							
	Data Transmission-I	08						
	Multiplexing and Demultiplexing, introduction to modulation and demodulation, Analog and Digital Modulation techniques,							
	Data Transmission-II	08						
Unit-2	Pulse code formats used in data transmission, Frequency division and time division multiplexing, time division multiplexing using mechanical commutator, Electronic time division multiplexing,							

Converters		(
Digital to Analog Electromechanical	g Converters (DAC), Analog to Digital Converters (ADC), ADC, Digital Transducer	
Recorders		(

- 1. AK Sawhney, "*Electrical and Electronic Measurement and Instrumentation*", DhanpatRai and Sons, 1993
- 2. EO Doebelin, "Measurements Systems- Application and Design", Tata McGraw Hill, 1975
- 3. HS Kalsi, "Electronic Instrumentation", Tata McGraw Hill, 2004
- 4. Munez-Ruiz, Angel and Vromans, Herman, "Data Acquisition and Measurement Techniques", CRC Press, 1998

List of Practicals: IE-313

- 1. To construct weighted Resistance type of Digital to Analog converter
- 2. Study of Time-division multiplexing (TDM) Pulse Amplitude Modulation/Demodulation with Transmitter clock and channel identification information linked directly to the Receiver.
- 3. Study the effect of reconstructed wave form by the use of Sample/Hold circuit.
- 4. To study the Pulse Code Modulation.
- 5. To construct and study the Butterworth first order low pass filter.
- 6. To construct and study the Butterworth first order high pass filter with given cut off frequency.
- 7. To study the second order low pass active filter.
- 8. To study the second order high pass active filter.
- 9. To construct and study the all pass filter.
- 10. To construct and study the Band pass filter.
- 11. To construct the circuit for summer and differentiator using operational amplifiers.
- 12. To construct the circuit for integrator and differentiator using operational amplifiers.
- 13. To construct the circuit for Voltage to Current converter and Current to Voltage converter using operational amplifiers.
- 14. To study the digital half adder circuits.
- 15. To study the digital full adder circuits.

IE-314Mechanical Measurements-II

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Recall the theoretical and practical aspects of measurement.

CO 2: Identify different instruments used for the measurement of the different parameters.

CO 3: Classify the instruments for different applications and understand their working.

CO 4:.Differentiate the studied techniques for different applications and apply them.

CO 5:. Modify and develop some advanced technique for mechanical measurement.

Pre-requisite Knowledge:

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

COa					Progr	amme O	utcomes	(POs)				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S										
CO3			М	М		W						
CO4			S	S								
CO5			S	S		S			W			

Unit	Main TopicsCourse Outlines	Hour(s)							
	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 angle	08							
Unit-1	Decker Force and Torque Electric balance – different types of load cells – magnets – elastics load cell-strain gauge load cell-different methods of torque measurement, strain gauge, relative regular twist-speed measurement-revaluation counter- capacitive tacho-drag up type tachoD.C and A.C tacho generators – stroboscope.	08							
	Measurement of acceleration, vibration	08							

	Accelerometers – linear variable differential transformer (LVDT), piezo- electric, strain gauge and variable reluctance type accelerometers – mechanical type vibration instruments – seismic instrument as an accelerometer and vibrometer – calibration of vibration pick ups	
	Density, and pH measurement units of density, specific gravity and viscosity used in industries – Baume scale API scale – pressure head type densitometer – float type densitometer – ultrasonic densitometer Bridge type gas densitometer, pH measurement techniques	06
Unit-2	Measurement of viscosity, humidity and moisture Viscosity terms – say bolt viscometer – rotameter type viscometer – industrial consistency meters – humidity terms – dry and wet bulb psychrometers – hot wire electrode type hygrometer – dew cell – electrolysis type hygrometer – commercial type dew point meter – moisture terms – different methods of moisture measurement – moisture measurement in granular materials, solid penetrable materials like wood, web type material.	10

- 1. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005
- 2. D.Patranabis, *Principles of Industrial Instrumentation*, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
- 3. A.K. Sawhney and PuneetSawhney, A course on electrical and electronic measurements and instrumentation, DhanpatRai, 2012.
- 4. P.Holman, *Experimental Methods for Engineers*, International Student Edition, McGraw Hill Book Company, 1971.
- 5. B.C.Nakra and K.K.Chaudary, *Instrumentation Measurement and Analysis*, McGraw Hill Publishing Company Ltd., New Delhi, 1985.
- 6. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005

List of Practicals: IE-314

- 1. Measurement of thickness using vernier, slip gauge
- 2. Angular measurement using sine bar, sine centre
- 3. Force measurement using load cells
- 4. Strain measurement using strain gauges
- 5. Torque measurement using stroboscope
- 6. Measurement of acceleration using LVDT, piezo-electric methods
- 7. Measurement of pH
- 8. Measurement of density
- 9. Measurement of viscosity
- 10. Measurement of humidity

IE-315 Microprocessors and Microcontrollers

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

- CO 1: Study 8085 microprocessor internal architecture, timing diagrams and interrupts.
- CO 2: Learn instruction format of 8085 microprocessor, addressing modes and program development tools
- CO 3: Develop programming loop structure with counting and indexing for 8085 microprocessor
- CO 4: Learnarchitecture of 8051microcontroller, its special registers and port operation.
- CO 5: Understand to develop the programme of 8051 microcontroller using different instructions.

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

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
	8085 microprocessor Hardware Architecture pintouts - Signals – Memory interfacing – input/output (I/O)	12
	ports and data transfer concepts, Timing Diagram, Interrupt structure.	
lit-]	PROGRAMMING OF 8085 PROCESSOR	12
Un	Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation and control instructions – Programming: Loop structure with counting and Indexing – Look up table - Subroutine instructions - stack.	
	Microcontroller 8051 hardware and architecture	12
	Introduction to 8051 microcontroller, Architecture and Memory Organization, Special function registers, Port operations	
it-2	Programming of 8051 microcontroller	12
Un	Programming model of 8051, operand types, operand addressing, Data transfer instructions, Arithmetic Instructions, Logic Instructions, Control transfer instructions, Programming	

Recommended Books-

1. B.Ram., Fundamentals of Microprocessors and Microcomputers. DhanpatRaiand Sons, 1998.

- 2. Douglas V. Hall, Microprocessors and interfacing: Programming and Hardware, Tata McGraw Hill, 2007.
- 3. Gaonkar and Ramesh S., Microprocessor Architecture, Programming and Applications with the 8085, Penram International.
- 4. Ray A.K. and Bhurchandi K.M., Advanced Microprocessors and Peripherals, Tata McGraw Hill (Ed.), Prentice Hall, 1997.

IE-321 Elements of Computer Programming

L	Т	Р	Credits	Weekly Load
2	0	2	3	4

Course Outcomes:

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

CO1: Learn steps in development of a program, flow Chart and debugging.

CO2: Understand program structure, input/output function and control statements

CO3: Implement Array and function in a programming

CO4: Learn basic of Pointers to various data types and structures

Pre-requisite Knowledge: Nil

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

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

Unit	Main Topics and Course Outlines	Hour(s)					
	Algorithms and Program Development Steps in development of a program, Flow Chart, Algorithm Development, Program debugging.	04					
Unit-1	Program Structure Data types,Input/Output statements, assignment statements; variables; arithmetic logical and relational operators – their precedence. logical and relational operators, standard input/output (I/O) functions, formatted input/ output (I/O). Input/ output using files.						
	Control Statements for statement, if-then-else, while, do-while, break, switch statements.	04					
Unit-2	Functions and Arrays Function declaration, parameters, parameter passing, call-by-value, call-by- reference, storage classes (local, global and static variables), function prototype, Single and multi-dimensional arrays, character arrays.	08					

Pointers	0.4			
Introduction to Pointers and Pointers to various data types.	04			
Introduction to Structures				
Definition of a structure, pointers to structures, union, arrays of structures.	04			

- 1. E. Balaguruswamy, *Programming in ANSI C*, 6th edition, Mcgraw Hill Education, 2012.
- 2. John R. Hubbard, Schaum's Outline of Programming with C++, Schaum's Outline Series, 2000.
- 3. R Subburaj, *Programming in C*, 1st edition, Vikas Publishing, New Delhi, 2000.

List of Practical: IE-321

- 1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
- 2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
- 3. WAP to calculate the area and circumference of a circle.
- 4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5=(F-32)/9.
- 5. WAP that swaps values of two variables using a third variable.
- 6. WAP that checks whether the two numbers entered by the user are equal or not.
- 7. WAP to find the greatest of three numbers.
- 8. WAP that finds whether a given number is even or odd.
- 9. WAP that tells whether a given year is a leap year or not.
- 10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:

Between 90-100%-----Print 'A' 80-90%-----Print 'B' 60-80%-----Print 'C' Below 60%-----Print 'D'

- 11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
- 12. WAP to print the sum of all numbers up to a given number.
- 13. WAP to find the factorial of a given number.
- 14. WAP to print sum of even and odd numbers from 1 to N numbers.
- 15. WAP to print the Fibonacci series.
- 16. WAP to check whether the entered number is prime or not.
- 17. WAP to find the sum of digits of the entered number.
- 18. WAP to find the reverse of a number.
- 19. WAP to print Armstrong numbers from 1 to 100.
- 20. WAP to convert binary number into decimal number and vice versa.
- 21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
- 22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
- 23. WAP to find the minimum and maximum element of the array.
- 24. WAP to search an element in a array using Linear Search.
- 25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
- 26. WAP to add and multiply two matrices of order n x n.
- 27. WAP that finds the sum of diagonal elements of amxn matrix.
- 28. WAP to implement strlen (), strcat (), strcpy () using the concept of Functions.

IE-322 Case Study of Process Plants

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO1: Understand the working of different types of process equipment's used in process plants

CO2: Learn the block diagram, Pand ID of process plant

CO3: Know the process of different types of plants

CO4: Acquire the knowledge of Instrumentation and control used in different types of plants

Pre-requisite Knowledge: IE-225 and IE-314, Mechanical Measurements

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	М			W										
CO2	М			W										
CO3	W						W							
CO4	М						W			М	М	W		

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	Introduction Study of different types of Distillation columns, Boilers, Chillers, Reactors, Heat Exchangers, Compressors etc	24
Unit-2	Instrumentation and control of Plants Study of Processes, Block Diagram, flow diagram, Instrumentation and control of Hydro Power Plant, Cement Plant, Sugar Plant, Fertilizer Plant, Paper and Pulp Plant, Food Industries etc	24

Recommended Books-

Text Book

- 1. Dr.Divya Prasad, Instrumentation and Control System, AICTE Continuity Education Program
- 2. G. N. Pandey, A Textbook of Chemical Technology, vol I and II, Vikas Publishing House
- 3. William G. Andrew, H.B. Williams, *Applied Instrumentation in the Process Industries: Engineering Data and Resource*, 3rd edition, Gulf Publishing Co, 1993.

Reference Books

1. B. G. Liptak, Process Control: Instrument Engineers' Handbook, 3rd edition, Butterworth Heinemann, 1995.

2. Gregory K. Mcmillan, Douglas M. Considine, Process/Industrial Instruments and Controls Handbook, 5th edition, McGraw-Hill Professional, 1999.

List of Practical: IE-322

- 1. Study of Distillation column.
- 2. Study of Boiler.
- 3. Study of Chiller.
- 4. Study of Reactor.
- 5. Study of Heat Exchanger.
- 6. Study of Compressor.
- 7. Flow chart of Hydro Power Plant.
- 8. Flow chart of Cement Plant.
- 9. Flow chart of Sugar Plant.
- 10. Flow chart of Fertilizer Plant
- 11. Flow chart of Paper plant.
- 12. Flow chart of Pulp Plant.
- 13. Flow chart of Food Industry.
- 14. Flow chart of chemical industry.

IE-323 Industrial Automation and Safety

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

- **CO1:** Understand the basics of PLC architecture and PLC programming.
- CO 2: Develop a PLC program for an automatic control system of a medium degree of complexity
- CO 3: Understand the Distributed Control System and illustrate the different parts .
- **CO 4:** Discuss automation system as network communication and safety and protection against interference.

Pre-requisite Knowledge:

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

Unit	Main Topics and Course Outlines	Hour(s)
	Introduction to Programmable Logic Controllers (PLC)	06
	Advantages and disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.	
	PLC programming methodologies:	10
Unit-1	Ladder diagram, Statement List (STL), functional block diagram, creating ladder diagram from process control descriptions, introduction to IEC61131 international standard for PLC.	
	PLC functions:	08
	Bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer and Counter functions on-delay timer, off-delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics	
Jnit- 2	Distributed Control System (DCS)	12

Evolution of DCS, Architecture of DCS, Direct Digital Control, Hierarchical structure, different functional levels, database organization for DCS, data communication link, reliability and consideration in DCS, flow sheet symbols	
Area classification and Intrinsic Safety	12
Hazardous Area definitions, Protection methods, NEMA enclosures, Ingress Protection, Purging and intrinsic safety.	

- 1. LIPTAK, Instrumentation Engineering Handbook, Chilton Book Company
- 2. ANDREWS: Applied Instrumentation in Process Industries (Volume II and III)
- 3. DOEBLIN: Measurement Systems: Application and Design, TMH
- 4. R. K. JAIN: Mechanical and Industrial Measurements, Khanna Publishers

List of Practicals: IE-323

- 1. To study Ladder logic programming of a industrial PLC like SEIMENS/FATEK/MICROLOGIX
- 2. To write programme for control of Drinks machine,.
- 3. To write a Programme for Car Parking.
- 4. To study step step sequence in a PLC
- 5. To write a programme and interface simulated hardware unit of Tank level control.
- 6. To write a programme and interfaceand control a traffic light using PLC.
- 7. To write a programme and interface and control a simulated elevator control using PLC
- 8. To write a programme and interface and control a conveyer belt using PLC
- 9. To write a programme and interface and control speed of a DC motor using PLC
- 10. To write a programme and interfaceand temperature control system using analog outputs of a PLC.

IE-324 Power Electronics and Drives

L	Т	Р	Credits	Weekly Load
3	0	2	4	5

Course Outcomes:

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

CO 1: Able to understand Power semiconductor devices , their properties and characteristics.

CO 2: Familiarize the principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications..

CO 3: Study of sinusoidal analysis of resonant converters and its applications.

CO 4: Understand concept of inverters which consist of halfand full bridge, single and three phase etc.

CO 5: Understand Electric Drive and Power Quality problems generated by various electric drives.

(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											М	
CO2	S												
CO3		М										W	
CO4	M												
CO5	S						М						

Theory:

Unit	Main Topics andCourse outlines	Hour(s)
	Power Semiconductor Devices Thyristor (silicon controlled rectifier (SCR)), their Symbol, Construction and Operation, voltage-current (V-I) Characteristics, Thyristor Turn on and Turn off (commutation) methods; Thyristor Specifications and Ratings; thyristor protection circuits; Heat Sinks and Mountings, Thyristor Family and other power semi- conductor devices: Symbols and V-I Characteristics.	06
Unit-1	Converters Converters : Un-controlled and controlled, Half wave and Full wave, Half controlled and full controlled, Single Phase and three phase, with Resistive Load and RL Load, with and without Freewheeling Diode, Comparison of 3 phase and single phase Converters, Effect of Source Impedance on Converter Operation; Cyclo-converters: Single phase and three phase, principle of operation, Input output waveforms. Inverters Classification of Inverters: Voltage source and current source, single phase and three phase, Half Bridge and Full Bridge; Line Commutated and Forced Commutated; Series and Parallel; Operation of these inverters; Voltage and Frequency Control of single phaseInverters, Pulse Width Modulation(PWM) controlled Inverters,	09 09
	DC-DC Converters Converter Classification : Buck, Boost and Buck-Boost, Isolated and non isolated topologies, single switch, two and four switches topologies; their operation and	06
Unit-	applicationsChoppersChopper Principle, Control Techniques: Constant Frequency and VariableFrequency; Classification of Choppers: Class A, Class B, Class C, Class D and ClassE; Commutations Methods for Choppers	08

Applications to Industrial Systems									
DC Drives: Open loop and closed loop control schemes for Speed and torque control									
of DC motors, various topologies for these controls; AC Drives: Speed and torque									
control of three phase Induction Motor; Open/Closed loop control of stepper motor,									
AC/DC servomotor, and other special motors: Other Applications: Induction Heating									
Control, Electric Welding Control, Battery Charging Control, Static VAR									
Compensation System.									

- 1. G.K. Dubey, Power semiconductor drives, Prentice Hall Inc, 1989
- 2. Frank D. Petruzella, Industrial Electronics, , McGraw-Hill, 1995
- 3. Morris, Industrial Electronics, McGraw-Hill,London 1984
- 4. M.D. Singh and Khanchandani K.B, Power Electronics, 2nd Edition, TMH,2001

List of Practicals: IE-324

- 1. To identify the terminals and plot V-I Characteristics of Thyristor.
- 2. To identify the terminals and plot V-I Characteristics of Diac.
- 3. To identify the terminals and plot V-I Characteristics of Triac.
- 4. To study various turn on methods of Thyristor.
- 5. To study the waveforms of a single phase Full Wave converter Using Thyristor.
- 6. To study the waveforms of a single phase Half controlled Bridge converter Using Thyristor.
- 7. To study the waveforms of a single phase full controlled Bridge converter Using Thyristor.
- 8. To study the waveforms of a three phase half controlled Bridge converter Using Thyristor.
- 9. To study the waveforms of a three phase full controlled Bridge converter Using Thyristor.
- 10. To study the waveforms of a single phase Bridge inverter.
- 11. To study the waveforms of DC-DC converter in buck/boost mode.
- 12. To Perform Speed control of DC shunt motor by voltage control using single phase half/full controlled converter.
- 13. To perform speed control of three phase Induction motor using Rectifier and PWM Inverter.
- 14. To Perform speed control of any special machine using Rectifier and PWM Inverter.

IE-325 Telemetry and Display Devices

L	Т	Р	Credits	Weekly Load
2	0	0	2	2

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

CO1: Understand the basics of Data transmission methods.

CO2:Study general telemetry system and transmission channels considering their impact in global context.

CO3: Understand how data is to be transmitted through different techniqueslike TDM and FDM.

CO4: Learn basics of display devices and recognize their need in life.

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

Unit	Main Topics and Course Outline	Hour(s)						
Unit-1	Introduction Introduction to data transmission, methods of data transmission-Hydraulic, Pneumatic, Electrical or Electronic							
	Types of Telemetry Definition of telemetry, General requirements of telemetry system, Types of telemetry-Voltage Telemetry, Current Telemetry and Position Telemetry	06						
	Data TransmissionA. C. Telemetry and Concept of Digital telemetry- Pulse code modulation (PCM),Delta Modulation (Basic Principle (Only)							
Unit-2	Transmission Channel and Media wire line channels, Radio channels, Microwave channels, Power line carrier channel and optical fibre channels							
	Multiplexing and Demultiplexing Time division multiplexing (TDM) and frequency division multiplexing (FDM), Concept of CDMA (Code Division Multiple Access).							
	Display Devices Construction, principle of operation and salient features of various kinds of display devices-light-emitting diode (LED), Nixie tube,liquid crystal display(LCD),	08						

segmental	gas discharge	type, optical	displays
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- 1. AK Sawhney, "Electrical and Electronic Measurement and Instrumentation", DhanpatRai and Sons, 1993
- 2. D. Patranabis, "Telemetry Principles", Tata McGraw Hill, 2007
- 3. E.O Doebelin, "Measurements Systems- Application and Design", Tata McGraw Hill, 1975
- 4. EL Gruenberg, "Handbook of Telemetry and Remote Control", Tata McGraw Hill, 1967
- 5. HS Kalsi, "Electronic Instrumentation", Tata McGraw Hill, 2004
- 6. Munez-Ruiz, Angel and Vromans, Herman, "Data Acquisition and Measurement Techniques", CRC Press, 1998.