Shivaji University, Kolhapur

Instrumentation Engineering

Semester - III

Sr. No.	Name of Subject	Teaching scheme(Hrs)				Examination Scheme(Marks)				
--	--	L	T	P	Total	Theory	TW	POE	Oral	Total
1	Transducer Technology	4	-	2	6	100	50	50	-	200
2	Applied Electronics	4	1	-	5	100	-	-	-	100
3	Linear Integrated Circuits	4	1	-	5	100	-	-	-	100
4	Mathematics - III	4	-	-	4	100	-	-	-	100
5	Electrical Machines & Drives	4	-	2	6	100	50	50	-	200
6	Laboratory practice-I	-	-	2	2	-	50	50	-	100
		[20]	**[2]**	**[06]**	**[28]**	500	150	150	-	800

Laboratory Practice - I Includes Experiments for the subjects:-a) Applied Electronics
b) Linear Integrated Circuits

Semester - IV

Sr. No.	Name of Subject	Teaching scheme(Hrs)				Examination Scheme(Marks)				
--	--	L	T	P	Total	Theory	TW	POE	Oral	Total
1	Electronics & Electrical Measuring Instruments	4	-	2	6	100	50	50	-	200
2	Digital System	4	-	-	4	100	-	-	-	100
3	Networks & Circuit Theory	4	-	-	4	100	-	-	-	100
4	Statistical Methods in Instrumentation	3	1	-	4	100	-	-	-	100
5	Fluid flow & Heat transfer	4	-	2	6	100	25	-	25	150
6	Professional Communications	2	1	-	3	-	50	-	-	50
7	Laboratory practice-II	-	-	2	2	-	50	50	-	100
		[21]	**[2]**	**[06]**	**[29]**	500	175	100	25	800

Laboratory Practice-II Includes Experiments for the subjects: a) Digital System
b) Networks & Circuit Theory

S.E. INSTRUMENTATION (PART- I)

TRANSDUCER TECHONOLOGY

Teaching Scheme	**Examination Scheme**
Lectures : 4 Hrs / week	Theory: 100 Marks
Practicals: 2 Hrs / week	Term Work: 50 Marks
	POE: 50 Marks

Course Objectives: Upon completion of this course, student should be able to:

1. Understand the fundamentals of sensors and transducers.
2. Able to check the sensor according to given specifications
3. Know selection criteria of various types sensors.

Course Outcomes:

1. Student will able to understand basic of level, flow, temperature & pressure sensors etc.
2. Student will able to understand basic of motion, force, torque & weighing sensors.
3. Student will able to understand velocity acceleration, conductivity, viscosity, density, humidity sensors & vibration transducers.
4. Student will know the calibration of sensors.
5. Student will able to able to select proper sensor for proposed application.

Course Syllabus

Unit	Contents	Hrs
I	**Instrumentation System :** Definition of sensor and transducer, classification of transducers, performance characteristics, selection criteria, transducer specification, test and operating conditions, role of sensors in industry.	04
II	**Displacement, Force & Torque Measurement :** Linear Displacement : Resistive potentiometer, capacitive displacement transducer, LVDT, Hall effect sensor, fiber optic sensor Rotary Displacement: Tachometer, rotary encoder, stroboscope, gyroscope. Force: Basic methods of force methods, Strain gauge (principle, types, materials & properties), Load cell. Torque: Inductive torque transducers, digital method & magnetostrictive torsion transducer, dynamometer.	06
III	**Temperature Measurement**: Temperature scales, classification of Temperature sensors, calibration & selection	08

criteria of temperature sensors.
Thermometers: classification & specification of thermometers.
Resistive Temperature detectors: - Principle, types, configuration (2 wire, 3 wire & 4. wire), construction and working.
Thermistor:- Principle, types(NTC, PTC), construction & working, testing & applications.
Thermocouples:– Principle, Terminology(Thermo electric, See beck, Peltier effect), types (A,B,C,D,E,J,K,R,S,T) and characteristics, cold junction compensation methods, Thermo well-thermopile comparison.
Pyrometers : Principle, construction & working of total radiation pyrometer and optical pyrometer, applications.

IV **Flow Measurement:** **06**

Essential principles of fluid mechanics and properties of fluid, types of fluid flow, continuity equation, Bernoulli's equation, hydrostatic law and pascal's law, Selection criteria of flow sensors.
Head Type Flow Meter: Orifice, venturi, nozzle, pitot tube.
Variable Area Type Flow Meter: Rota-meter
Open Channel: Turbine, Target, Electro Magnetic, Ultrasonic, Vortex Shedding, anemometers.
Mass Flow Meter: Coriolis, Thermal & solid flow meters

V **Pressure Measurement**: 05

Pressure scales, units and relation, classification, selection criteria of pressure sensors.
Primary Pressure Sensors:
Elastic elements:- bourdon, diaphragm, bellows, types and properties, range and measurement.
Non elastic : Manometer
Secondary/ Electrical Pressure sensors : Capacitive, LVDT, photoelectric, Photo emissive-cell.
Low Pressure : Mc-Leod gauge, pirani gauge, ionization gauge.
High Pressure : Bridgeman type, Bulk modulus cell.
Differential Pressure: Force balance, DP cell, Capacitance delta cell.
Calibration using dead wet tester.

VI **Level Measurement:** **05**

Basic level measurement principals, Need for level measurement, types and classification, construction and working, selection criteria for level sensors. Dipstick, displacers, float, Bubblers, capacitive, conductivity, Differential level sensor, float level sensor, Laser level sensor, microwave level switch, radar Laser, optical level devices, radiation level sensor, time domain reflectometry and phase differential sensors, Ultrasonic level Detector , vibrating level switch , solid level detectors and application.

VII **PH, Humidity and Vibration Measurement:** **04**

PH : Nearnst equation, construction & working of pH sensor, temperature

compensation, pH measurement electrodes, maintenance and applications.
Humidity: Hygrometer (Hair, wire & electrolysis). Piezoelectric humidity meter, infrared, conductance & capacitive type probes for moisture measurement.
Vibration: Velocity pick up, acceleration pick up, proximity probes.

VIII Viscosity, Density and Miscellaneous: 5

Viscosity: Capillary type, saybolt type, falling and rolling ball type viscometer, variable area viscometer.
Density: Displacement and float type densitometer, Hydrometer, Hydrostatic Head (Air bubbler & DP Cell)
Miscellaneous: Conductivity cells and probe, sound level sensor, Leak detector, proximity sensors (Inductive & Capacitive)

Reference Books:

1. CS.Rangan ,G,R,Shrma , V.S.Mani - Instrumentation Devices and systems -TATA Publication.
2. A J.Morris - Principles of measurement & Instrumentation - PHI Publication.
3. D.V.S Murthy : Transduers and Instrumentation - PHI Publication.
4. A.K. Ghosh - Introduction to Instrumentation and control - PHI Publication.
5. Sabric Soloman - Sensors and control systems in manufacturing -TATA McGrawHill Publication.
6. Nakra Chaudhry: Instrumentation measurement and analysis
7. A.K.Sawhney : Electrical and Electronic measurement and instrument
8. D.Patrick, Fardo- Industrial Process Control System- Thomson learning Inc.
9. E.O.Doebelin : - Measurement system application and Design IV edition.
10. Patranabis - principle of industrial instrumentation.
11. B.G.Liptak - Process measurement and analysis(Hand book).

Term Work:
It shall consist of a record of at least 09 experiments from the following list.

1. To study and observe the LVDT Characteristics
2. To study and observe the Thermocouple Characteristics
3. To study and observe the RTD Characteristics
4. To study and observe the Thermister Characteristics
5. To study and observe the Strain Gauge Characteristics
6. To study and observe performance of Level Transducer(Resistive type)
7. To study and observe performance of Flow Measurement.
8. To study and observe performance Pressure Gauge
9. To study and observe the LDR characteristics.
10. To study and observe performance of Magnetic pickup
11. To study and observe performance of Capacitive pickup
12. To study and observe performance of Differential Pressure Transmitter

* * * * *

S.E. INSTRUMENTATION (PART I)
APPLIED ELECTRONICS

Teaching Scheme:
Lectures: 4 Hrs/week
Tutorial: 1 Hr/Week

Examination Scheme:-
Theory Paper: 100 Mark

Course Objectives: Upon completion of this course, student should be able to:

1. Know the fundamentals of electronic circuits and components.
2. Implement amplifier circuits using electronic components.
3. Design and implement oscillators, multivibrators and power amplifiers.

Course Outcomes:

1. Student will able to understand application of semiconductor diodes.
2. Student will able to understand construction & working of transistors & amplifiers.
3. Student will able to understand application of feedback amplifiers.
4. Student will able to design multivibrators & oscillators.
5. Student will able to understand various power amplifiers.

Course Syllabus

Unit	Contents	
I	**MULTISTAGE AMPLIFIER :-**	**[6]**
	Classification, distortion, noise frequency response, of RC coupled amplifier, Low frequency Response of RC coupled amplifier. Effect of an bypass capacitor on low frequency response. High frequency response of two cascaded CE transistor stages.	
II	**JFET** :-	[8]
	JFET construction, symbol, Basic operation, VI Characteristics, Transfer characteristics, Cut off & pinch off voltages, Tran conductance, Input resistance & capacitance. Drain to source resistance, JFET as voltage controlled current source. JFET data sheet specification :- IDSS, Vp, gain rd, RDS JFET amplifiers: - CS, CD & CG MOSFET, Types :- specifications	
III	**POWER AMPLIFIER :-**	**[8]**
	Classification of power amplifiers, Class A, Class B, Class AB, Class C. Class A with resistive load, Transformer coupled class A amplifier, Class B push pull, complementary symmetry. Efficiency analysis for class A transformer coupled amplifier, Class	

B push-pull Distortions in amplifiers. Boot strapping in complimentary symmetry & bias compensation used in push-pull amplifiers.

IV LINEAR WAVE SHAPING :- [6]

Linear wave shaping & time base Application of diode as voltage doublers, Tripler & voltage quadruple configuration. Clipping & Clamping circuits. Integrator & differentiator circuits. VJT, saw tooth generator.

V FEEDBACK AMPLIFIERS & OSCILLATORS:- [8]

Concept of feedback, Negative & Positive feed back, advantages & disadvantages of negative feedback.

Oscillators :- Bark criteria for oscillators using JFET & BJT) (derivations not expected)

LC Oscillators :- Hartley, Colpitts.

RC Oscillators :- Phase shift & Wein bridge.

VI MULTI VIBRATORS:- [6]

Astable, Bistable, and monostable, multivibrators. Schmitt trigger, its waveforms, applications & working.

References Books :-

1) Integrated Electronics :- milluass Hall :- TATA McGraw Hill.
2) Pulse Digital & Switching waveforms :- Jacob Millman & Hilbert TATA McGraw Hill.
3) Electronic Devices & Circuit theory :- Boylestead Nashad.
4) Electronic Devices & Circuit theory :- M.Allen Mottershed
5) Applied Electronics :- R.S. Shreedhar.
6) Principles of Electronics :- V.K. Mehta.

* * * * *

S.E. INSTRUMENTATION (PART-I)

LINEAR INTEGRATED CIRCUITS

Teaching Scheme:
Lectures: 4 Hrs/week
Tutorial: 1 Hr/Week

Examination Scheme:-
Theory Paper: 100 Mark

Course Objectives: Upon completion of this course, student should be able to:

1. Operational amplifier basics and their characteristics
2. Analysis and design of various op-amp based linear circuits.
3. Applications of linear integrated circuits.

Course Outcomes:

1. Student will able to design op amp based circuits.
2. Student will know applications of op-amps.
3. Student will able to understand application of comparators & wave form generators.
4. Student will know comparison between active and passive filters.

Course Syllabus

Unit	Contents	Hrs
I	**Operational Amplifier (Op-amp) Fundamentals:** Block Diagram of Op-Amp including internal circuits and analysis, Ideal & Practical Op-amp specifications, Transfer characteristics of Op-amp, Op-amp parameters & measurement: Input & output offset voltages, Input & output offset currents, Input Bias current, slew rate, CMRR, PSRR, Thermal drift. Comparative study of Data Sheets (LM 741, OP 07, LM 324, LM 311, LM 308, LM380, CA 3140.)	8
II	**Effect of Feedback in Op- Amplifier:** Introduction to feedback amplifiers, Voltage series feedback, (Non-inverting amplifier with feedback), deriving close loop gain , Voltage follower and it's applications, Voltage shunt feedback (Inverting simplifier with feedback), deriving close loop gain, Study of differential amplifier.	6
III	**General Applications of Op-amp:** Inverting, non-inverting and differential amplifier configuration and their special cases: summing, scaling and averaging. Sign changer, voltage follower, and differential amplifiers using one and two op-amps. Integrator, differentor, precision rectifiers (half wave & full wave) , voltage to current converter, current to voltage converter, Isolation amplifier, Instrumentation amplifier.	8

IV **Comparator And Wave Form Generator:** 6

Basic comparator ,comparator characteristics, application of comparator as ZCD, Schmitt trigger ,window detector. Square, triangular and saw tooth wave generator circuit. Sample and hold circuit, peak detector.

V **Active Filters and Oscillators:**

Active filter: Comparison between active and passive filters. Frequency response of op-amp Classification: First and Second order Butterworth filters. Low pass, High pass, Band pass, and band Stop. Analysis for cut off frequency and design of filters is expected. 8

Oscillators: Operating principles, Barkhausen's criteria, R.C. Phase shift and wein bridge oscillator using IC741.Limitation of op-amp in oscillator design.

VI **Study of some important IC's:**

Features. Pin configuration, Internal block diagram and applications of above ICS is expected. 6

SE/NE 555 (Timer), 78XX and 79XX (voltage regulator) , IC's 565,566 S.E/NE 565 (PLL) & S.E. / NE 566 (Voltage controlled oscillator)

Refrence Books: -

1. Ramakant A. Gaikwad, Op-amp and Integrated circuits, Fourth edition, PHI Publication, 2002.
2. William D. Stanley, "Operational Amplifiers With Linear Integrated Circuits", 4th ed., Pearson Education India, 2002.
3. Sergio Franco, Design with Op-amp and Analog Integrated circuits, Tata McGraw Hill Edition, New Delhi.
4. V. Rajaram, Analog Computation and Simulations, Prentice Hall of India, New Delhi.
5. Robert F. Coughlin and Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits.
6. L. K. Maheshwari and M.M. S Anand, Analog Electronics, Prentice Hall of India, New Delhi.

* * * * *

S.E. INSTRUMENTATION (PART-I)

MATHAMATICS - III

Teaching Scheme
Lectures : 4 hrs / Week

Examination Scheme
Theory: 100 Marks

Course Objectives: Upon completion of this course, student should be able to:

1. Understand basic mathematics.
2. To use mathematical concepts in instrumentation engineering

Course Outcomes:

1. Student will be able to understand Linear & partial differential equations.
2. Student will be able to understand Fourier series.
3. Student will be able to find z transforms of various functions.
4. Student will be able to find Laplace transforms and inverse Laplace transforms.
5. Students will able to understand fuzzy sets.

Course Syllabus

Unit	Contents	Hrs
I	**Linear Differential Equations** 1.1 Linear Differential Equations with constant coefficients Definition, Complementary function and Particular integral (without method of variation of Parameters). 1.2 Applications of Linear Differential Equations with constant coefficients to Electrical systems.	**8**
II	**Vector Calculus** 2.1 Differentiation of vectors 2.2 Gradient of scalar point function and Directional derivative 2.3 Divergence of vector point function and Solenoidal vector fields. 2.4 Curl of a vector point function and Irrotational.	**7**
III	**Unit 3 Fourier series:** 3.1 Definition, Euler's Formulae, Dirchilt's Condition. 3.2 Functions having points of discontinuity 3.3 Change of interval 3.4 Expansion of odd and even periodic functions 3.5 Half range series.	**5**

IV	**Unit 4 Laplace Transform:** 4.1 Definition, Transforms of elementary functions, Properties of Laplace transform. 4.2 Transforms of derivatives and Integral. 4.3 Inverse Laplace transforms formulae. 4.4 Inverse Laplace transforms by using partial fractions and Convolution theorem. 4.5 Solution of Linear differential equation with constants coefficients by Laplace transforms method.	**8**
V	**Unit 5 Z – Transform:** 5.1 Definition, Some standard Z – transform. 5.2 Properties of Z – transforms. 5.3 Region of Convergence 5.4 Inverse Z – transform.	**6**
VI	**Unit 6 Introduction to Fuzzy sets:** 6.1 Basic concepts of fuzzy sets 6.2 Crisp set and Fuzzy set. 6.3 membership functions 6.4 Basic operations on fuzzy sets 6.5 Properties of fuzzy sets	**6**

Reference Books:

1. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar , Vidyarthi Griha Prakashan, Pune.
2. Higher Engineering Mathematics by Dr. B. S. Grewal.
3. Advanced Engineering Mathematics by Erwin Kreyszig.
4. Advanced Engineering Mathematics, by H. K. Das (S. Chand Publication.)
5. Advanced Engineering Mathematics, by Merle C. Potter (OXFORD University Press)

* * * * *

S.E. INSTRUMENTATION (PART-I)

ELECTRICAL MACHINES & DRIVES

Teaching Scheme
Lectures : 4 Hrs / Week
Practicals : 2 Hrs / Week

Examination Scheme
Theory: 100 Marks
Term work : 50 Marks
POE : 50 Marks

Course Objectives: Upon completion of this course, student should be able to:

1. Understand various types of electrical machines.
2. Understand speed measurement & control techniques.
3. Understand special purpose machines.

Course Outcomes:

1. Student will able understand different speed control strategies.
2. Student will able to understand synchronous machines.
3. Student will able to learn controls for 3-phase induction motor.
4. Student will able to understand power factor correction.
5. Student will able to understand electrical drives.

Course Syllabus

Unit	Contents	Hrs
I	**Polyphase Circuits:** Introduction to 3 phase system, Star & Delta connections, Relationship between line and phase quantities, measurement of Active & Reactive power in 3 phase balanced loads by two watt meter and one watt meter method, Calculation of load power factor by two wattmeter method (numerical treatment) Effect of load power factor on two wattmeter readings.	8
II	**Three phase transformers : -** Construction, types, connections of 3 phase transformer : star / Delta, Delta / Star , Star/ Star , Delta / Delta, Vee-Vee connection, Scott connections.	5
III	**Synchronous Machines**: - Three phase alternators,- construction, types ,e.m.f. equation, voltage regulation, parallel operation and synchronizing. Three phase synchronous motors :- Construction, working principle, effect of change in excitation on armature	8

current and power factor, Vee curves, methods of starting, hunting , applications.

IV **Three phase induction Motors :-** **10**

Construction, types, Production of rotating magnetic field, working principle and operation of motor. Equations of starting torque, maximum torque, torque under running conditions, Ratios Ts / Tmax, Tf / Tmax, Torque –sleep characteristic, effect of rotor resistance on Tmax, Power stages in motor (numerical treatment) equivalent circuit. Speed control from stator and rotor side, starters for 3 phase induction motor.

V **Special Purpose Machines: -** **6**

Stepper motors types, applications, construction and working of variable reluctance and permanent magnet stepper motors

Servo motors – Construction, working of D.C. & A.C. servo motors, applications

Reluctance and Hystersis motor - Construction, working , applications.

Tacho generators & Synchros,

VI **Introduction to electrical drives** **6**

Advantages and disadvantages of electrical drives. Types of motors used for electrical drives. Selection of electrical drives . classification of electrical drives – group drive, individual drive, multimotor drive. Important factors for selection of electrical drives

References Books :-

1) Control system Engineering – I.J. Nagrath , M. Gopal
2) Electrical Machinery (Sixth edition)- A.E. Fitzgerlad
3) Electrical Technology (vol I & II) B.L.Theraja
4) Principles of Electrical Machines – V.K. Mehata
5) Utilization of Electrical power - R. K. Rajput , Laxmi Publication Ltd.

List of Experiments :-

1) Measurement of active & reactive power in a 3 phase balanced load by one wattmeter method.
2) Measurement of active & reactive power in a 3 phase balanced load by two wattmeter method.
3) Load test on 3 phase induction motor
4) Study of 3 phase induction motors starters
5) To plot V curves and power factor curves for 3 phase synchronous motor.
6) Performance of various types of 3 phase transformer connection
7) study of synchro characteristic.

* * * * *

S.E. INSTRUMENTATION (PART-I)
LABORATORY PRACTICE – I

Practical : 2 Hrs / Week Term Work: 50 Marks

Course Objectives: Upon completion of this course, student should be able to:

1. Know basic electronic component
2. Design and implement oscillators, multivibrators and power amplifiers.

Course Outcomes:

1. Student will able to design various circuits.
2. Student will able to design multivibrators and power amplifiers.
3. Student will know basics of semiconductor devices.

Course Syllabus

Laboratory Practice –I includes 10 Experiments from the subjects:-a) Applied Electronics
b) Linear Integrated Circuits

I Applied Electronics-
1) Drain characteristics & Transfer characteristic JFET.
2) Frequency response of Single stage R.C. coupled amplifier.
3) To study clipping & clamping circuit. (negative & positive)
4) Phase shift oscillator.
5) Astable multi vibrator.
6) Class B push-pull amplifier :- operation & efficiency calculations.

II Linear Integrated Circuits
1) Study of op-amp
2) General application : A.C. , D.C., Inverting and Non inverting amplifiers.
3) Measurement of op-amp parameters.
4) Summing, Scaling, Subtractor.
5) Study of Integrator and differentiator
6) Study of comparator a) Zero crossing detector b) Schmitt trigger c) Window comparator
7) Study of square wave, Triangular wave, generator circuit using IC 741
8) Study of active filters, a) First and Second order Low pass filter b) First and Second order Highpass filter
9) Study of IC 555, a) Astable multivibrator, b) Mono stable multivibrator
10) Study of IC8038

* * * * *

S.E. INSTRUMENTATION (PART-II)

ELECTRONIC & ELECTRICAL MEASURING INSTRUMENTS

Teaching Scheme:
Lectures : 4 Hrs / Week
Practicals : 2 Hrs / Week

Examination Scheme:-
Theory: 100 Mark
Term work : 50 Marks
POE : 50 Marks

Course Objectives: Upon completion of this course, student should be able to understand:

1. Various Noises in electronics systems, their effects on operation and remedies.
2. Testing of electronic components and instruments.
3. Principle and working of electronic instruments their operation specifications and applications.

Course Outcomes:

1. Student will able to understand various measurement standards.
2. Student will able to understand performance characteristics of instruments.
3. Student will able to understand various calibration types.
4. Student will able to understand comparison of measuring instruments.
5. Student will able to understand signal generators, various types of analyzers & recorders.

Course Syllabus

Unit	Contents	Hrs
I	**Theory of Measurement And instrumentation** Block diagram of Instrumentation system, Classification of measurement instruments Primary B) Secondary-Indicating, integrating, and recording analog /Digital. **Static Characteristics**-Accuracy ,Precision, error, linearity, resolution, sensitivity, dead zone, drift, hysteresis , **Dynamic Characteristics** -Error, Speed Response, fidelity, lag, dynamic error Instrument specification and factors affecting on instruments.	8
II	**Analog and digital Meters** D'arsonval, Ballistic galvanometer, working principle and application Advantages and disadvantages PMMC, PMMI , Ohmmeter, Digital Meters-1) Integrating and non integrating type voltmeter 2)Frequency, time, and phase measurement Calibration of Devices: types - primary , secondary, direct, indirect & routine calibration.	6
III	**Electrical Measurement and techniques** Current Transformer, Potential transformer, power factor meter, Synchro-scope, Energy meter, Trivectormeter, Wattmeter, frequency meter, max. Demand meter, Grounding and Isolation and use in measurement.	8

IV **Measurement Of R,L,C** 8

D.C. Bridges- D.C. bridge: whetstone bridge, kelvins bridge, kelvins double bridge (principle, working, advantage &disadvantage)

A.C. bridges- **Measurement of inductance** : Maxwell's bridge, Andersons bridge, Hay Bridge Measurement of mutual inductance : Hearyside bridge, **Measurement of capacitance** : Desauty's bridge, schering bridge, **Measurement of frequency** : Wein bridge, Errors in bridge circuits and Remedy, wagner earthing device , introduction of LCRQ meter

V **Oscilloscope and Laboratory Devices** 10

Block diagram of CRO, Types of Oscilloscope: Dual beam, dual trace, sampling digital storage Oscilloscope, CRO accessories: Passive and active probes, Application of CRO: Measurement of phase, frequency using lissijous patterns .Measurement of inductance and capacitance

Signal generator: AF sine wave & square wave generator, square wave & pulse generator (lab type) , Random noise generator, function generator, pulse generator

VI **Recorders and Display Divices** 6

Analog and Digital Displays, Alarm Annunciators (Types), Pilot lamps, LED LCD,& segment Displays,Analog Recorders-Strip Chart recorders ,X-Y recorders and Types,

Reference Books:

1 Cooper llelfric - Modern Electronic Instrumentation and Measurement Technique - PHI
2 Kalsi U.S. - Electronic Instrumentation — TATA McGrawHill Publication.
3 Clyde f Coombs, Jr - Electronic instrumentation Handbook.
4 A.K.Sawhney - A course in Electrical & Electronic measurement & Instrumentation.
5 Oliver Cage- Electronic Measurement and Instrumentation -TMG.

List of Experiments

01 To study of Cathode Ray Oscilloscope
02 Measurement of Frequency and Phase On CRO
03 To study of Digital multimeter.
04 Study of LCR-Q Meter.
05 Measurement of Whetstones Bridge
06 To study Parameter of Capacitor
07 To study Parameter of Inductor
08 To study lissijous pattern
09 To study of Energy meter
10 Study of Maxwell's Bridge.
Design of ohmmeter (Series & Shunt)

* * * * *

S.E. INSTRUMENTATION (PART-II)
DIGITAL SYSTEM

Teaching Scheme:
Lectures: 4 Hrs/week

Examination Scheme:-
Theory: 100 Mark

Course Objectives: Upon completion of this course, student should be able to:

1. Know the fundamentals of digital logic and Number systems.
2. Implement logical operations using combinational logic circuits.
3. Implement synchronous state machines using flip-flops.
4. Understand Microprocessor programming and interfacing.

Course Outcomes:

1. Student will able to understand number systems.
2. Student will able to understand logic gates & Boolean algebra.
3. Student will able to know registers and counters.
4. Student will know architecture and programming of 8085.
5. Student will able to design microprocessor based circuits for applications

Course Syllabus

Unit	Contents	Hrs
I	**Boolean Algebra & Combinational Circuits** Laws of Boolean algebra, De-Morgan's thermos. Relating a truth table to a Boolean expression. Combinational Circuits: K-Maps and their use in simplifying Boolean Expressions, min-term, max-term SOP & POS implementation. Implementing a logic function using universal gates.	5
II	**Combinational Logic Circuit Design** Half subtraction , Full subtraction , Parallel Binary adders, BCD Adders, Parity Bit generating, Comparators, BCD to 7 segment decoder, PLA devices, generic array logic devices, Display devices - LED, LCD. Features, Pin-out & applications of the following devices: 7400, 74244, 74245, 74373, 74LS138, 7447, 7448, FND 542, FND 543, 74181(ALU).	5
III	**Use of Multiplexers in Logic Design** Multiplexer, De-multiplexer, encoder, Line Decoder (3 TO 8) 8421**,** designing using multiplexer, de-multiplexers, decoders. IC's of MUX, DEMUX, Decoders. Hazardous in combinational circuits.	3
	Sequential Logic Circuits	5

IV **Flip Flops**: S-R, J-K, and T, switch De-bouncing Flip Flops with additional inputs. Characteristic Equations & timing diagrams.
Shift registers & Counters.
Shift registers -Types, Data transmission in shift register, Serial in parallel out, parallel in serial out & parallel in parallel out shift register. Types of Counters - Synchronous, Asynchronous, Ring, up down, Mod N Counters, study of IC 7490 & IC 7493.

V **Logic Families** 2
TTL, tri state gate ECL, IIL, MOS devices CMOS comparison of logic families

VI **Introduction to 8085** 8
Introduction to microprocessor, Features of 8085, 8085 CPU architecture, functional pin configuration, de-multiplexing of address & data bus. 8085 block diagram. 8085 Instructions set, Addressing modes, Functional classification of instruction set and programming.

VII **8253: Programmable Interval Timer** 3
Introduction, Features, Pin Configuration, Functional Block Diagram, Modes of Operation, Interfacing.

VIII **8255: Programmable Peripheral Interface** 3
Features, Pin Configuration, Functional Block Diagram, Operating Modes, Interfacing.

IX **8257: Direct Memory Access Controller** 3
Features, Pin Configuration, Functional Block Diagram, Operating Modes, Interfacing.

X **Interfacing applications to 8085** 3
Keyboard, displays, ADC, DAC, Thumbwheel switches, Relays, Stepper motor

Reference Books

1. Malvino leach, Digital Principles & electronics , TMH
2. A. Anand Kumar, Fundamental of Digital Circuit , PHI
3. Alan B Marcorits – Introduction to logic Design
4. Charles Roth – Fundamental & logic Design, Thomson
5. R.P. Jain – Modern Digital Electronics
6. Morris Mano – Digital Logic & Computer Design
7. Introduction to measurement & Instrumentation, Arun Ghosh, PHI
8. Microprocessor Architecture – Programming & application with 8085 – Ramesh Gaonkar
9. Microprocessor & Digital System – Donglous Hall
10. Microprocessor & Programmed Logic – Kenneth L. Shart

* * * * *

S.E. INSTRUMENTATION (PART-II)
NETWORK & CIRCUIT THEORY

Teaching Scheme:
Lectures: 4 Hrs/week

Examination Scheme:-
Theory: 100 Mark

Course Objectives: Upon completion of this course, student should be able to:

1. Know the fundamentals of electronic component.
2. Understand various network theorems.
3. Understand electrical circuits and analysis.

Course Outcomes:

1. Student will able to understand various network theorems.
2. Student will able to solve various circuit problems.
3. Student will able to find various parameters for electrical transmissions.
4. Student will able to design filter circuits.

Course Syllabus

Unit	Contents	Hrs
I	**Network Fundamentals:** Basic Definitions: Passive Network, Active Network, Linear Element, non-linear elements, Unilateral, bilateral, lumped & distributed elements. Representation of voltage & current sources. (Ideal & practical) , source transformation, series & parallel connection of passive elements(R,L,C) Star- Delta transformation, reduction of networks: KCL, KVL, Mesh analysis, Node analysis.	06
II	**Network Theorems:** Linearity, Proportionality and superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, compensation theorem, Millman's theorem, Principle of duality, network solution by laplace transformation techniques .	08
III	**Two port network & Network functions:** Two port network: Open circuit impedance (Z) parameters, Short circuit admittance (Y) parameters, Hybrid (H) parameter, Transmission parameters(ABCD), Interrelation of different parameters, Interconnections of two port network (Series, Parallel, Cascaded, Series- Parallel) T & P representation .	06
IV	**Resonance:** Defination , Types: series & parallel resonance. Series resonance- resonant frequency, variation of impedance, admittance, current & voltage across L & C w.r.t. frequency, Effect of resistance on frequency response,	06

Selectivity , B.W.& Quality factor.
Parallel resonance – Anti resonance frequency, variation of impedance & admittance with Frequency, Selectivity & B.W.

V **Filters & Attenuators:** 10

Definitions, classification & characteristics of different filters, filter fundamental such as attenuation constant (L) , phase shift (K) propagation constant (Q) characteristic impedance (Zo) ,decibel ,neper. Design & analysis of constant K , M derived & composite filters (low pass, high pass, band pass & band stop filters): T & P sections.
Attenuators - Definitions, classification , relation between neper & decibel . Analysis & design of T type, P type , L Lattice , bridged- T & L types attenuators

VI **Transient Response:** 06

Steady state & transient response (Voltage & Current)
DC response of RL circuit
DC response of RC circuit
DC response of RLC circuit
Sinusoidal response of RL, RC & RLC circuit

Reference Books: -

1) Circuits and networks: Analysis and synthesis

A. sudhakar, shyammohan sp (Tata Mc-Grawhill)

2) Network analysis and synthesis – Umesh sinha.

3) Electric circuit Analysis – P. Ramesh babu

4) Network analysis and synthesis – M. Arshad (Laxmi public.)

5) Network analysis and synthesis – Soni Gupta

6) Introduction to Electric circuit - R.C.Dorf, J.A. Svoboda (Wiley Publications)

7) Network Analysis By M.E. Van Valkenburg (Third Edition)

* * * * *

S.E. INSTRUMENTATION (PART-II)
Statistical Methods in Instrumentation

Teaching Scheme
Theory: 3 hrs / Week
Tutorial : 1 hrs.

Examination Scheme
Theory: 100 Marks

Unit 1: **Measurements basics**, basic physical quantities, measurement scales: nominal, ordinal, interval, metric and ratio scales, units, fundamental and derived units, standards and practices, physical standards for length, mass, time, primary, secondary and tertiary standards,

Unit 2: **Characteristics of measuring instruments:** Concepts of accuracy and precision, error as a measure of inaccuracy, random and systematic errors, precision, range and span, resolution, threshold, sensitivity, bias, dead band, hysteresis, reproducibility, calibration of instruments

Unit 3: **Probability Theory**: Probability definition, sample space, event, axioms of probability, repeated trials, concept of random variable, distributions and density functions, Conditional probability and total probability, Bay's theorem,

Unit 3: **Random Variables:** Random variables, mean, central tendency, median, mode, mean as a least-squares estimate, validation standards for accuracy, standard deviation, degrees of freedom, random (or indeterminate) errors

Unit 4: **Distribution functions**: Normal distribution. Central limit theorem. moments and characteristic function. Other distributions: Chi-Square, Poison, Binomial, Exponential, and Laplacian distribution functions. Concept of statistical independence

Unit 5: **Statistical Analysis of Data**: Hypothesis testing, defining null hypothesis, and test statistics, Type-1, Type-2 errors, student-t test, Z-test, F-test, Chi-square test.

Unit 6**: Stochastic processes**

Introduction to stochastic processes: Definition and classification, Markov chains, stationary distribution and ergodicity, Wiener process, Gaussian process,

Reference Books

1. A. Papoulis, Probability, Random variables and stochastic processes, McGraw Hill, 1991.

2. Starks and Woods, Probability and Estimation Theory, Prentice-Hall

3. M. R. Spiegel, Probability and Statistics, Schaum's Outline Series, McGraw -Hill Book Company, 1982.

* * * * *

S.E. INSTRUMENTATION (PART-II)

Fluid Flow and Heat Transfer

Teaching Scheme	**Examination Scheme**
Theory: 4 Hrs / Week	Theory: 100 Marks
Practical: 2Hrs	Term Work -25
	Oral-25

Course Objectives: Upon completion of this course, student should be able to:

1. Understand basics of mechanical system
2. Know turbines, fluid mechanics, Pumps and Heat exchangers.

Course Outcomes:

1. Student will able to understand high/ low pressure boilers.
2. Student will able to understand various types of turbines.
3. Student will know pumps and types of heat exchangers.
4. Student will able to understand fluid dynamics.
5. Student will able to understand pressure drop through pipes.

Course Syllabus

Unit	Contents	Hrs
I	**Properties of Fluids** Characteristics of Fluids ,Density, Specific Weight, Specific Gravity, Dynamic Viscosity, Kinematics, Viscosity, Surface Tension, Capillarity, Compressibility, Vapor pressure. Pascal's Law, Pressure at a point, Total Pressure, Centre of pressure, Pressure on a plane inclined and curved surfaces, Buoyancy, metacenter and floatation	05
II	**Fluid Kinematics and dynamics** Types of flows (steady unsteady, uniform, non-uniform, laminar, turbulent, compressible, incompressible, rotational, Irrotational),Reynolds Number, Visualization of flow field (Stream, Path and Streak line), Continuity and Linear momentum derivation of Bernoulli's equation along stream line , application of Bernoulli's equation to venture meter, Pitot tube, Orifices, Orifice meter, types of (descriptive treatment)	08
III	**Hydraulic Machines** Basic Concept, Impulse turbine (Pelton wheel-Construction, working, Velocity Tringle, Equations). Reaction type turbine (Fransis ,Kaplan Principle, construction, operation, equations), turbine governing systems, specific speed of turbines. Centrifugal pumps(Working, construction, types of centrifugal pumps), methods of priming, speed calculation (Descriptive only)	06
IV	**Mechanism of heat flow**	04

Concept of thermal conductivity, basic modes of heat transfer (Conduction, Convection and Radiation),Heat transfer coefficient, overall heat transfer coefficient

V **Heat transfer by conduction in solids**
Fourier's law, steady state heat conduction through walls, single and multilayer. Heat flow through a cylinder, Sphere, unsteady state heat conduction, introduction to semi-infinite solid and critical radius of lagging, 07

VI **Industrial Boilers and Heat exchange equipment**
Types of boilers, (fire tube, water tube), Boiler mounting and accessories, boiler efficiency (Descriptive treatment). Types of heat exchangers, single and multipass exchangers, introduction to compact heat exchanger different types of condensers and boilers, air cooled heat exchangers . 06

VII **Principles of heat flow in fluids** 08
Co-current and counter current flow. Energy Balances, rate of heat transfer, overall and individual heat transfer coefficient. Calculation of overall heat transfer coefficients from individual heat transfer coefficients, fouling factors. Transfer units in heat exchangers (Descriptive treatment)

Recommended Books: -

1. Fundamentals of Fluid Mechanics- Munson, Young and Okiishi- Wiley India
2. Fluid Mechanics- Potter Wiggert –Cengage Learning
3. Introduction to Fluid Mechanics- Fox, Pichard , McDonald- Wiley
4. Fluid Mechanics,- Dr. R.K. Bansal- Laxmi Publication (P) Ltd. New Delhi
5. Fluid Mechanics,- Cengel&Cimbla- TATA McGraw-Hill
6. Fluid Mechanics- R.K.Rajput
7. Heat Transfer- R.K.Rajput
8. Heat Transfer- Dr. Sukhatme

Suggested Experiment list-

1. Study of charactristics of fluid.
2. Verification of Bernoulli's equation.
3. Calibration of Orifice meter.
4. Calibration of ventury meter.
5. Study the charactristics of pelton wheel
6. Study the charactristics of centrifugal pump
7. Thermal conductivity of insulating powder.
8. Study of Shell and Tube heat exchanger.
9. Study of forier's law of heat transfer

* * * * *

S.E. INSTRUMENTATION (PART-II)
PROFESSIONAL COMMUNICATIONS

Teaching Scheme:
Lectures : 2 Hrs / Week
Tutorial : 1 Hrs / Week

Examination Scheme:-
Term work : 50 Marks

Course Objectives: Upon completion of this course, student should be able to:

1. Improve communication skill.
2. Develop interview techniques.
3. Understanding of social, environmental & ethical issues related to professional work

Course Outcomes:

1. Students will improve their communication skills.
2. Students will be able to develop good professional skills.
3. Students will get prepared for facing various career interviews.
4. Students will understand the dynamics of team work.
5. Students will able to solve personal & interpersonal problems.

Course Syllabus

Unit	Contents	Hrs
I	**Introduction**: People in Social & Business context, role of core & soft skills, Graduate Attributes, skill sets, career planning & scope for development. Aspects of personal & industrial safety.	4
II	**Self Improvement**: Self Analysis: Attitude, Aptitude, self esteem, confidence, motivation & analysis tools (e.g. SWOT) Self Development: Decision Making, Goal Setting, Action Plans, Time, Change & stress Management, use of development support tools (Lists, tables, forms, Mind Maps, physical exercise, meditation, etc.)	4
III	**Technical Communication:** Effective Listening, Reading, and Understanding of content. Effective Notes taking, writing, preparing proposals resume & project reports Effective Oral communication in academic activities such as orals, seminar & project presentations, Group Discussions, Interviews & Industrial Training	4

IV	**Working in Teams**: Understanding Group Dynamics, gender etiquettes, body language & working effectively within teams Defining common objectives, building rapport, motivation, leadership, negotiation & resolving conflicts Planning for technical project work & use of project evaluation tools.	4

Term Work:

Activities conducted in following areas
1. SWOT Analysis
2. Self Development Plans
3. Demonstration of reading skills
4. Role playing
5. Group activity on poster/model presentation
6. Group Discussion/ Debate on Current issues.
7. Identifying Role Models / motivational posters/audio/video
8. Writing of reports / resume or a mini presentation.
9. Visit to library to explore technical resources /mini projects.
10. Invited expert lectures by a doctor/industrialist/ professional counselors.
11. Stress management activities/ visit to Gymnasium.
12. Mock Interview.

Reference Books :

1. Communication Skills for Engineers by C Murlikrishna & Sunita Mishra, Pearson
2. Developing Communication Skills, Krishna Mohan & Meera Banerji, Macmillan.
3. Soft Skills for Managers, by Dr Kalyana Chakravarthi & Dr Latha Chakravarthi, bizantra.
4. How to prepare for Group Discussion & Interview, Hari Mohan Prasad & Rajnish Mohan, TMH
5. Target setting & Goal achievement, Hale & Whilom, Kogan Page
6. Emotional Intelligence, Daniel Golman
7. Working in Teams, Harding, Orient Longman
8. Adam's Time Management, Marshall Cooks, viva books
9. Presentation Skills, Michael Hutton ISTE.

* * * * *

S.E. INSTRUMENTATION (PART-II)
LABORATORY PRACTICE – II

Teaching Scheme:
Practical : 2 Hrs / Week

Examination Scheme:-
Term work : 50 Marks
POE : 50 Marks

Course Objectives: Upon completion of this course, student should be able to:

1. Know various network theorems.
2. Know the fundamentals of digital logic and linear integrated circuits.
3. Know various network theorems
4. Design of digital and analog circuits using IC's.

Course Outcomes:

1. Student will able to find current through desired elements.
2. Student will able to design basic gates.
3. Student will able to understand microprocessor programming.
4. Student will know interfacing of microprocessor
5. Student will able to find current through desired elements.

Laboratory practice – II will consist of at least 6 experiments each from following subjects

1) Network & Circuit Theory
2) Digital Systems

Network & Circuit Theory-

1) Kirchoffs Law justification.
2) Maximum power transfer (practical justification)
3) Thevenin's theorem and Norton's theorem for
4) Node Analysis
5) Mesh Analysis
6) Superposition Theorem
7) Nortons Theorem
8) Thevenins Theorem
   a) A.C Circuit b) D.C Circuit.
9) Plotting of behavior of RC circuit for step input.
10) Plotting of behavior of RI circuit for step input.
11) Plotting of behavior of RLC circuit for step input.
12) Plotting of behavior of RLC circuit for ramp input.
13) Frequency response of series resonance circuit.
14) Determination of Z,Y & H parameter of given network.
15) To determine frequency response of Low pass, high pass, band passes RLC Filter.

Digital System

1) Study of gates(AND, OR , X-OR)
2) Study of NAND ,NOR as universal gates
3) Study of D-Morgans theorem
4) Study of De-Multiplexer
5) Study of Multiplexer
6) Study of Flip-flops(S-R,J-K);
7) Study of counters
8) Study of shift registers
9) Study of 8085
10) 8/16-bit addition
11) 8/16-bit substration
12) Block transfer
13) Block exchange
14) Study of 8255(Mode -0.Mode-1,Mode-2);
15) Study of DAC using 8255
16) Study of stepper motor using 8255

* * * * *

Class: S.E. (Instrumentation)

Semester -I		
Sr. No.	**Subject (Old)**	**Equivalence Subject (New)**
1	Applied Engineering Mathematics (Sem-I)	Maths3 (Sem-I)
2	Electrical Machines (Sem-I)	Electrical Machines &Drives (Sem-I)
3	Electrical Measurements & Instruments (Sem-I)	Electronics & Electrical Measuring Instruments (Sem-II)
4	Circuit Theory & Analysis (Sem-I)	Networks & Circuit Theory (Sem-II)
5	Electronics Devices & Circuits (Sem-I)	Applied Electronics (Sem-I)
6	Instrumentation System Components (Sem-I)	-
6	LABORATORY PRACTICE: I- 1. Electronics Devices & Circuits (Sem-I) 2. Circuit Theory & Analysis (Sem-I)	LABORATORY PRACTICE: I- 1. Applied Electronics (Sem-I) 2. Linear Integrated Circuits (Sem-I)
Semester -II		
1	Digital Systems & Microprocessor (Sem-II)	Digital System (Sem-II)
2	Automatic Control System (Sem-II)	--
3	Sensors &Transducers (Sem-II)	Transducer Technology (Sem-I)
4	Thermal & Fluid Power Engineering (Sem-II)	Fluid flow & Heat Transfer (Sem-II)
5	Linear Integrated Circuits(Sem-II)	Linear Integrated Circuits(Sem-I)
6	Programming Technique-I (Sem-II)	---
7	LABORATORY PRACTICE: II- 1. Digital Systems & Microprocessor (Sem-II) 2. Linear Integrated Circuits(Sem-II)	Laboratory practice-II 1. Digital System (Sem-II) 2. Networks & Circuit Theory (Sem-II)

Dr. S. S. Admuthe