



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160915

Semester – VI

Subject Name: Electrical Measurements and Measuring Instruments

Type of course: Professional Core Course

Prerequisite: NA

Rationale: Electrical installations ranging from residential consumers to huge industrial estates all are equipped with measuring instruments. In view of this, study of principles of Electrical measurements and measuring instruments becomes mandatory for all electrical engineers. This subject deals with principles of measurements, analog and measuring instruments as well as transducers.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Concepts of Measurement : Measurement System, Classification of instrument system, Methods of Measurement, Static Characteristics like accuracy, precision, sensitivity, linearity, range, reproducibility, drift, threshold, dead zone etc. Dynamic Characteristics like speed of response, fidelity overshoot etc., Measurement Standards Errors in measurement, Basic statistical evaluation of measurement data and errors - mean, standard deviation, Six sigma estimation.	06
2	Transducers and Sensors : Definition, different types of transducers, criteria for selection, general characteristics and dynamic characteristics, transducers for measurement of temperature ((Thermocouple and RTD), transducers for measurement of pressure, strain, transducers for measurement of displacement, speed, torque, Hall Effect transducer Sensors – basic concept – Speed and position sensors	10
3	Measurement of Parameters : Measurement of resistance, , Extending the range of meters - Shunts, Potential divider, Instrument Transformer and their applications in the extension of instrument range, Measurement of voltage, current, power, energy, power factor and frequency (constructions and operating principles of corresponding instruments)	10
4	Measurement of R, L and C : Different methods of measuring low, medium and high resistances, Wheatstone Bridge,	10



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	Measurement of inductance & capacitance with the help of AC Bridges (Hays Bridge, Schering Bridge, Maxwell bridge, Anderson Bridge), LCR meter - working principle with block diagram	
5	D.S.O. : Digital recorders, Digital Storage Oscilloscope - Block Diagram, theory and applications, Power scope.	03
6	Display devices: Characteristics of digital display, DVM and Digital multi meter, Clamp on meter, Megger.	03

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	30	20	10	10	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Gupta J. B., "A Course in Electronics and Electrical Measurements and Instrumentation", S.K. Kataria & Sons
2. A.K.Sawhney, "Electrical and Electronic Measurements and Instrumentation", DHANPAT RAI & CO.
3. Golding & Widis, 'Electrical Measurement and Measurement instrument', Wheelar Books
4. D. Patranabis, 'Sensors & Transducers', PHI.
5. H. S. Kalsi, " Electronic Instrumentation", Tata McGraw-Hill Education.
6. A.J. Bouwens, 'Digital Instrumentation', Tata Mc-Graw hill.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Comprehend the basics of electrical measurements.	20
CO-2	Explain basic principle, working, characteristics and applications of the various measuring instruments and transducers.	40



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CO-3	Apply AC and DC bridges for measurement of electrical parameters like resistance, inductance and capacitance.	20
CO-4	Prepare the specifications of required measurement systems to be used for measurement of parameters for a specified application.	20

List of Experiments:

- To measure value of unknown capacitance by Schearing's bridge.
- To measure unknown inductance by & demonstrate operation of Maxwell's bridge.
- To demonstrate distance measurement using LVDT.
- To demonstrate the Kelvin Double Bridge for Low resistance measurement.
- To measure value of unknown capacitance by Owen's bridge.
- To measure value of unknown inductance using LCR meter.
- To measure high resistance and insulation resistance using Megger.
- To demonstrate usage of DSO for steady state periodic waveforms produced by a function generator.
- To measure value of unknown capacitance using LCR meter.
- Measurement of current using shunt.

Major Equipment:

Necessary number of meters, accessories and instruments etc... to be provided to conduct the above experiments in a group of maximum 4 students. Charts and cut section models of various instruments should be provided for better understanding.

List of Open Source Software/learning website:

- <http://www.scilab.org/>
- <http://www.vlab.co.in/>