GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3132405
Semester – III
Subject Name: Measurement and Instrumentation

Type of course: Engineering Science

Prerequisite: 1. Basic Electrical Engineering 2. Basic Electronics

Rationale: Our life is becoming more and more dependent on automation. The equipment are becoming smarter day by day. COnsidering all this, the role of measurement and instrumentation is increasing in our life and industry. In view of this, it is essential for any electrical / electronic engineering graduate to know the basic aspects of electrical measurement and instrumentation. This subject deals with basic principles of measurement, characteristics of instruments, working principle of measuring various electrical and non electrical quantities, oscilloscope, display devices etc. The knowledge gained can be used in other subjects and professional life where these principles of measurement can be applied.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Introduction:** Generalized instrument system, Measurements, Instruments, Static characteristics of instruments like accuracy, sensitivity, reproducibility, dead zone, etc. Static errors. Dynamic characteristics of instruments, Concept of transducers, Active and Passive transducers.	6
2	**Electrical Measuring Instruments:** Analog Meters, Electromechanically meter movements, PMMC, Analog DC ammeters, Analog DC voltmeters, Analog AC ammeters and Voltmeters, Analog multimeters, Special purpose analog meters, Use of basic meters, meter errors, problems. Extending the range of meters, Loading effects and their elimination, true rms voltmeters, Principle of DVM and Digital multimeter, working of Current Transformer and Potential Transformer for	8

	measurement. Measurement of Power in AC-DC circuits, single phase power measurements, Poly-phase power and measurements, Electrical energy measurements	
3	**Measurement of R, L and C:** Principles and methods of measurement of resistance, inductance and capacitance, working principle of LCR meter with block diagram.	4
4	**Measurement of other physical quantities:** Measurement of important physical quantities like temperature, pressure, flow, displacement, level, strain etc. Working principle of transducer used for measurement of these quantities.	10
5	**Oscilloscope:** Oscilloscope subsystem, Principle of Operation, Display subsystem, Oscilloscope probes, Oscilloscope controls, Front panel of an oscilloscope, Lissajous patterns oscilloscope photography, Digital storage oscilloscopes (DSO), Power scope. Attenuation probes, Time Measurements, Frequency measurement using oscilloscope	6
6	**Signal Conditioning:** Requirements, Block diagram approach of signal conditioning, amplification, filtering, linearization, modulation and demodulation, Dynamic compensation, DC and AC compensation system, signal transmission etc., Digitization of analog signals, Analog to digital conversion, brief idea about methods of A/D conversion, Sample and Hold circuit and its importance.	4
7	**Display Devices:** Classification, characteristics of digital display, Digital display elements	4

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
10	25	20	5	5	5

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. Electronic Instrumentation, 3/e, H.S. Kalsi, Mc Graw Hill
2. Electrical and Electronic Measurements and Instrumentation - A.K.Sawhney
3. Modern Electronic Instrumentation and Measurement Techniques -Cooper, Helfrick

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand measuring instruments and their characteristics.	20
CO-2	Apply measurement concept during laboratory sessions various subjects	25
CO-3	Understand and apply concepts of signal conditioning	35
CO-4	Use different display devices.	20

List of Experiments:

Sr. No.	**Title**	**Remarks**
1	Study of generalized measurement system and its characteristics.	
2	Study of extension of range of voltmeter.	
3	Study of extension of range of ammeter.	
4	Study of temperature measurement	
5	Study of oscilloscope and its use for measurement of frequency, pulse width etc.	

6	Study of measurement of inductance, resistance and capacitance.	
7	Study of signal conditioning requirements for instrumentation and measurement system.	
8	Study of display devices	

Major Equipment: DSO, AC/DC bridges, Power and Energy meters, load etc.

List of Open Source Software/learning website:

1. **https://nptel.ac.in/**
2. **https://en.wikipedia.org/wiki/Electricity_meter**
3. **https://en.wikipedia.org/wiki/Electric_power**
4. **https://en.wikipedia.org/wiki/Transducer**
5. **https://en.wikipedia.org/wiki/Oscilloscope**
6. **http://www.ni.com/tutorial/3981/en/**
7. **https://en.wikipedia.org/wiki/Temperature_measurement**
8. **https://en.wikipedia.org/wiki/Signal_conditioning**