GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION & CONTROL ENGINEERING (17)
Bachelor of Engineering
Subject Code: 3131706
Semester – III
Subject Name: Measurement & Instruments

Type of course: Engineering Science

Prerequisite: Basic Electrical Engineering, physics.

Rationale: To prepare students for experiments and design with various electrical, electronic measurements and instrumentation systems.

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:** Types of instruments: Indicating, recording, integrating, etc. **Experimental Data and Errors:** Measurement Recording and Reporting, Graphical Presentation of Data, Precision and Accuracy, Resolution and Sensitivity, Errors in Measurement, Statistical Evaluation of Measurement Data and Errors	4
2	**Analog DC and AC 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.	5
3	**Digital Meters:** DVM and Digital multimeter, vector voltmeters, 7 Segment and LCD display.	3
4	**Oscilloscope:** Oscilloscope subsystem, Principle of Operation, Lissajous patterns oscilloscope photography, Digital storage oscilloscopes (DSO), Power scope. Attenuation probes, problems	3
5	**Time & Frequency Measurement:** Time Measurements, Frequency measurement, Harmonic Analysis and spectrum analyzers, Frequency Mixer problems.	3
6	**Power & Energy Measurement:** Power in AC-DC circuits, single-phase power measurements, Poly-phase power and measurements, Measurement of Power factor, Electrical energy measurements, Power measurements problems	4

7	**Measurement of Resistance & Bridges :** Resistance and resistor, resistor type, measurement of resistance, Wheatstone Bridge, Making balanced Wheatstone Bridge measurement, Low value resistance measurement (Kelvin Double Bridge), problems. **Measurement of Capacitance, Inductance, and Impedance:** Hays Bridge, Schering Bridge, Maxwell bridge, Anderson Bridge, Q-factor, Capacitance and capacitors, capacitor circuit models and losses, capacitor types, color coding of capacitor, Inductor and Inductance, Inductor structure, Transformers, Impedance, Capacitance and Inductance, Capacitance and Inductance measurement, complete impedance measurement, frequency measurement, problems	**6**
8	**Current and Potential transformers**: Testing and Applications.	**2**
9	**A.C. Signal Sources:** Sweep Frequency generators, Pulse generators, Function generators, Oscillators **Interference Signals and Their Elimination:** Capacitance interference, inductive interference and shielding, electromagnetic interference and shielding, conductive coupling interference, ground loop interference and input guarding to reduce it internal noise.	**3**
10	**Data transmission in Digital Instrument System:** RS 232C Standard, 20mA Current Loop	**3**

Note: Sequential Design Example* (Tutor/Instructor/Teacher has to select one case study and carry forward same to teach all the topics of syllabus.)

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
28	**28**	**7**	**7**	**7**	**-**

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. Wolf & Smith, Student reference manual for Electron ic and Instrumentation measurement, PHI Publication.

2. E.W. Golding and F.C. Widdis, Electrical measurements and measuring instruments, Pitman Publishing.
3. Bemard Oliver and John Cage, Electronic Measurement s and Instrumentation, Tata Mcgraw Hill.
4. William d.Cooper, Albert d. Helfrick, Electronic Instrumen tation and measurement techniques, Prentice – Hall.
5. A.K.Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpatrai Publication.
6. H.S. Kalsi, Electronic instrumentation.
7. Kim Fowler, Electronic Instrument Design, OUP, USA, 1996.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Operate modern electrical and electronic instruments like CRO, DSO, DMM and other digital and analog instruments for appropriate measurement parameters.	30
CO-2	Able to measure time, frequency, power and energy parameter and use AC & DC bridges concept and their application for relevant parameter measurement.	40
CO-3	Able to test and troubleshoot electronic circuits using CT and PT. Carry out analysis of interference signals and their elimination for various applications.	30

List of Experiments:

1. Measurement of the voltage and Current using Analog Meter.
2. Extend the range of given ammeter and Voltmeter.
3. Measurement of unknown resistance with Wheatstone bridge.
4. Measurement of low resistance with Kelvin double bridge.
5. Measurement of unknown Inductance with a.c. bridge
6. Measurement of unknown capacitance with a.c. bridge.
7. Operation of CRO, DSO for voltage, current and frequency measurement, Lissajous patterns, phase angle measurements.
8. Calibration of single phase energy meter direct loading.
9. Calibration of single energy meter.
10. Measurements of power factors.
11. Develop application using CT and PT.
12. Develop application using RS-232C and 4-20mA current Loop.

Major Equipment:

CRO, DSO, AC/DC bridges, LCR meter, Power and Energy meters, load trolley etc.

List of Open Source Software/learning website:

1. http://nptel.iitk.ac.in/courses/Elec_Engg/IIT%20Bombay/Electrical%20and%20Electronic%20Measur ements.htm