

GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION & CONTROL ENGINEERING (17)

MEASUREMENT & INSTRUMENTS

SUBJECT CODE: 2141704

B.E. 4th Semester

Type of course: Core

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
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Types of instruments: Indicating, recording, integrating, etc.	2	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.	6	10
3	Digital Meters: DVM and Digital multimeter, vector voltmeters, 7 segment and LCD display. Analog to Digital Converters and Digital to Analog Converters,	6	10
4	Oscilloscope: Oscilloscope subsystem, Principle of Operation, Cathode Ray Tube ,Display subsystem, Vertical deflection subsystem, Dual trace/Dual beam feature, Horizontal deflection subsystems, oscilloscope probes, oscilloscope controls, Front panel of an oscilloscope, Lissajous patterns oscilloscope photography, Digital storage oscilloscopes (DSO), Power scope. Attenuation probes, problems	8	15
5	Time & Frequency Measurement: Time Measurements, Frequency measurement, Harmonic Analysis and spectrum analyzers, Frequency Mixer problems.	3	10
6	Power & Energy Measurement: Power in AC-DC circuits, single-phase power measurements, Poly-phase power and measurements, Electrical energy measurements, Power measurements problems	4	10

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.	8	20
8	Current and Potential transformers, testing, and applications.	3	5
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	6
10	Measurement of Power factor and frequency with analog and digital meters. Magnetometer. Miscellaneous measurements: speed, velocity.	5	10

Suggested Specification table with Marks (Theory):

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

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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 Electronic and Instrumentation measurement, PHI Publication.
2. E.W. Golding and F.C. Widdis, Electrical measurements and measuring instruments, Pitman Publishing.
3. Bernard Oliver and John Cage, Electronic Measurements and Instrumentation, Tata Mcgraw Hill.
4. William d.Cooper, Albert d. Helfrick, Electronic Instrumentation 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 Outcome:

After learning the course the students should be able to:

1. Operate modern electrical and electronic instruments like DSO, Digital Multimeter, and other digital and analog instruments.
2. Find faults and test various instruments and justify their use in systems.
3. Carry out Engineering design of various meters or select instruments for various applications.

List of Experiments: (Outlines)

1. Find the unknown resistance with Whistone bridge.
2. Find unknown capacitance with a.c. bridge.
3. Measure power in single/3-phase circuit.
4. Extend the range of given ammeter.
5. Perform experiment on energy meter and learn to take readings.
6. Operation of CRO, DSO for voltage, current and frequency measurement, Lissajous patterns, phase angle measurements.
7. Find unknown inductance with given a.c. bridge.
8. Find low resistance with Kelvin double bridge.
9. Understanding functioning of modern digital multimeters and their computer interface.

Design based Problems (DP)/Open Ended Problem:

Design Multi range voltmeter and ammeter by extending ranges of given meters.

Major Equipment:

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

List of Open Source Software/learning website:

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

http://en.wikipedia.org/wiki/Electricity_meter

http://en.wikipedia.org/wiki/Electric_power

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.