GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL (09) / POWER ELECTRONICS (24)

ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS

SUBJECT CODE: 2130903

B.E. 3rd Semester

Type of Course: Engineering Science **(ELECTRICAL)**

Prerequisite: N.A.

Rationale: N.A.

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		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Module 1: Philosophy Of Measurement- Methods of Measurement, Measurement System**,** Classification of instrument system, Characteristics of instruments & measurement system**,** Errors in measurement & its analysis, Standards.	02	10
2.	Module 2: Analog Measurement of Electrical Quantities – Electro dynamic, Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters, Electro dynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energymeter. Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor.	10	20
3	Module 3: Measurement of Parameters - Different methods of measuring low, medium andhigh resistances**,** measurement of inductance & capacitance with the help of AC Bridges, QMeter.	12	20
4	Module 4: Digital Measurement of Electrical Quantities-Concept of digital measurement, block diagram Study of digital voltmeter, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.	04	10
5	Module 5 Transducers: Definition - different types of transducers – criteria for selection –general characteristics–dynamic characteristics – transducers for measurement of displacement (RVDT &LVDT), speed, angular rotation, altitude, force, torque, humidity and moisture, pressure, strain and temperature (Thermocouple and RTD method), Hall Effect transducer and applications Instrumentation amplifiers – differential amplifiers –	12	30

	Data transmission and telemetry – methods of data transmission, General telemetry systems – Digital methods of frequency, phase, time and period measurements.		
6	Module 6 Display methods, recorders: Display methods and devices – different types of recorders – galvanometric recorders – pen driving system– magnetic recorders – digital recorders, digital storage oscilloscope (Block Diagram, theory and applications only)	02	10

Reference Books:

1. A.K.Sawhney, A course in Elect. & Electronic Measurement and Instrumentation, Dhapat Rai & Co.
2. Golding & Widis, Electrical Measurement and Measurement instrument, Wheelar Books
3. H.S. Kalsi, Electronic Instruments, Tata Mc-Graw hill.
4. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education.
5. D. Patranabis, Sensors & Transducers, PHI.
6. A.J. Bouwens, Digital Instrumentation, Tata Mc-Graw hill.
7. A.D. Heltric & W.C. Copper, Modern Electronic instrumentation & Measuring instruments, Wheeler Publication.
8. H.K.P. Neubert, Instrument transducers, Oxford University press.

Course Outcomes:

After learning the course the students should be able to

- Understand the working principal and construction of the measuring instruments and recorders.
- Measure various electrical and physical quantities and parameters using meters and transducers.
- Calibrate the measuring devices such as meters and transducers.

List of Practical including Open Ended Problems:

1. a) Calibration of single phase energy meter by direct loading b) Calibration of single phase static energy meter.
2. Calibration of single phase energy meter by phantom loading with and without phase shifting transformer.
3. Calibration of 3 phase energy meter a) phantom loading b) using phase shifting transformer.
4. Measurement of self and mutual inductance a) air cored coil b) iron cored coil.
5. a) Determination of B- H curve b) Determination of hysteresis loop using six point method.
6. Calibration of ammeter, voltmeter and wattmeter using vernier potentiometer

INSTRUMENTATION LAB

1. Measurement of resistance using Wheastone's Bridge and Kelvin Double bridge.
2. Extension of range of wattmeter using CT & PT
3. Measurement of displacement using LVDT
4. Measurement of current/ voltage using Hall effect transducer.
5. Thermocouple based ON – OFF controller
6. Measurement of physical quantities – strain, torque and angle
7. Measurement of temperature by RTD method
8. Measurement of low resistance by Kelvin‟s double bridge;
9. Measurement of voltage, current and resistance using dc potentiometer;

10. Measurement of inductance by Maxwell‟s bridge, Hay‟s bridge, Anderson‟s bridge;
11. Measurement of capacitance by Owen‟s bridge, De Sauty bridge, Schering bridge;
12. Measurement of flow rate by anemometer;

* The course coordinator has **to define at least 3 open ended problems** related to the courses.

Major Equipments:

The necessary Kits, Breadboard, equipments, accessaries and instruments to be provided to conduct the above practicals in a group of max. 4 students.

List of Open Source Software/learning website:

Open Source Sfteware:

- LTSpice for circuit simulation,
- KiCAD for CAD application

Web-based tools for design:

- http://www.fairchildsemi.com/support/design-tools/power-supply-webdesigner/
- http://www.ti.com/lsds/ti/analog/webench/overview.page

Circuit Lab:

- https://www.circuitlab.com/editor/

Open source Math Tools:

- http://maxima.sourceforge.net/
- http://www.sagemath.org/
- http://www.scilab.org/
- http://www.gnu.org/software/octave/

Learning website

- http://www.electrical-engineering-portal.com/
- http://nptel.iitm.ac.in/courses.php

Active learning Assignments (AL) : 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.