GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3162005
Semester – VI
Subject Name: Electro Mechanical Measurement and Instruments

Type of course: Professional Elective Course

Prerequisite: Zeal to learn the subject

Rationale: Course gives idea about the fundamentals of various terms and techniques of measurements of mechanical and electrical physical quantities. The different instruments used for measurements are discussed.

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	Basic Concepts: Introduction to Measurements and Instrumentation, Significance of Measurements, Standards of Measurements, Methods of Measurements, Modes of Measurements, Classification of Instruments, Basic Standards and Units, Primary, Secondary and Working Standards, Generalized Measurement Systems and its Functional Elements, Input-Output Configurations of Measuring Instruments and Systems.	5
2	Instrument characteristics and Errors in Measurements: Static Performance Characteristics, Dynamic Performance Characteristics, Standard Test-Input, Zero, First and Second Order Instruments, First Order System Responses, Second Order System Responses. Limiting Errors, Types of Errors, Sources of Errors, Statistical Analysis of Test Data, Curve Fitting, Application of Computers for Data Analysis, Selecting an Instrument, Selection of Measurement System.	10
3	Speed, Acceleration and Frequency Measurements: Mechanical Tachometer, Electrical Tachometer, Contactless Electrical Tachometers, Piezoelectric Accelerometer, Seismic Acceleration.	3
4	Force, Torque & Power Measurements: Load Cells, LVDT, Elastic Force Transducer, Mechanical Torsion Meter, Optical Torsion Meter, Strain Gauge Torsion Meter, Electrical Torsion Meter, Mechanical, Hydraulic and Electrical Dynamometry.	6
5	Principles of Operation of Electrical Instruments: Permanent Magnet Moving Coil and Moving Iron type instruments, DC Potentiometers	10

	and its applications, Resistance measurement: Different methods for measurement of high, low and medium resistance, Measurement of earth resistance, Introduction to instrument transformers (current transformers and potential transformers).	
6	Sensors and Transducers: Resistance Strain Gauges, Resistive Potentiometers and errors, Thermocouples and Thermoelectric laws, RTDs and Thermistors, Piezoelectric Sensors and loading effects, Inductive and Capacitive Transducers, Signal conditioning of sensors.	5
7	Digital Data Acquisition Systems: Basic functional elements of Digital Data Acquisition Systems, Introduction to Data Transmission and Telemetry, Introduction to Digital Signal Processing.	5

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
40	**25**	**15**	**10**	**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) D. S. Kumar, Mechanical Measurement and Control, Metropolitan Book Co.
(2) A.K.Sawhney, A course in Electrical and Electronic, Measurement and Instrumentation Dhanpat Rai & Sons
(3) E. O. Doeblin, Measurement Systems, McGraw Hill International Edition
(4) R. K. Rajput, Mechanical Measurements and Instrumentation Katson Books
(5) T. G. Beckwith Mechanical Measurements Narosa Publishing House
(6) Nakra B.C. and Chaudhray K. K. Instrumentation, Measurement and Analysis Tata McGraw Hill
(7) D. V. S. Murthy Transducers and Instrumentation Prentice Hall of India

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply the knowledge gained for mechanical and electrical measurements in the field.	40

CO-2	Design the multidisciplinary instruments for measurement of specific entity.	40
CO-3	Analyse the measured data/observations collected from the actual application for evaluating the system performance with respect to specifications and standards.	20

List of Experiments:

1. To calibrate a bourdon tube pressure gauge using a dead weight gauge tester.
2. To find out the effect of temperature on the kinematic viscosity of a fluid.
3. Calibration of RTD using liquid in glass thermometer.
4. Angular speed measurement of a rotating shaft.
5. Torque measurement using dynamometer.
6. To study the construction and working of PMMC and Moving iron instruments.
7. To extend the range of an ammeters and voltmeters.
8. Calibration of ammeters and voltmeters using DC potentiometers.
9. Measurement and On-Off control of temperature using Thermocouples and Thermistors.
10. Measurement of Force using Load cell.
11. Measurement of Linear displacement with the help of LVDT.

Major Equipment:

1. PMMC and Moving Iron Instruments, DC Potentiometers, Standard Cells, Spotlight Galvanometers, Votage Ratio Box , Adjustable DC supply and flexible wires.
2. Temperature Sensors and Temperature Calibrators, Heating Elements and Relays.
3. Displacement Sensors (LVDT/RVDT), Strain Gauge Load Cells and Std. Weights.
4. Instrument Transformers, Rheostats, Single and Three phase variacs etc.
5. Redwood viscometer
6. Dead Weight Pressure Guage
7. Stroboscope

List of Open Source Software/learning website:

The website of NPTL may be utilized for additional learning.