GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (24)
INDUSTRIAL INSTRUMENTATION
SUBJECT CODE: 2152408
B.E. 5th SEMESTER

Type of course: Engineering Science (Electrical)

Prerequisite: 1) 2130901 - Circuits and Networks
2) 2130903 - Electrical Measurements and Measuring Instruments
3) 2142405 - Analog Electronics and its Applications

Rationale: This subject focuses on the study of different sensors and transducers used to sense various non electrical quantities, its conversion in usable form for the purpose of measurement and control in industrial applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Topic	Teaching Hrs.	Module Weightage%
1	Introduction: Generalized Measurement System, Basic characteristics of measuring device, Electrical transducers, Classification of transducers, Basic requirements of a transducer.	**04**	**10**
2	Displacement Measurement: Variable Resistance Device, Linear Variable Differential Transformer, Rotational Linear Variable Differential Transformer , Variable Capacitance Transducers, Piezoelectric Transducers, Hall Effect Devices, Proximity Sensors, Synchros and Resolvers, Digital Transducers, Ultrasonic Transducers.	**04**	**10**
3	Strain Measurement: Factors affecting Strain Measurements, Types of Strain Gauges, Theory of Operation of Resistive Strain Gauge, Gauge Factor, Types of Electrical Strain Gauges, Materials used for Strain Gauge, Gauging Techniques and other factors, Strain Gauge Circuits, Temperature Compensation, Applications of Strain Gauges.	**04**	**10**
4	Force, Torque And Speed Measurement: Strain Gauge Load Cell, Pressuductor Load Cell, Piezoelectric Force Transducers, Magnetostrictive Force Transducers, In-Line Rotating Torque Sensors, In-Line Stationary Torque Sensors, Proximity Torque Sensors,	**06**	**15**

	Piezoelectric Torque Transducers, Resonant Tachometer, Magnetic Drag Tachometer, Tachometer Generators.		
5	Pressure Measurement: Strain Gauge Pressure Transducer, Piezoelectric Transducers, L.V.D.T. For Measurement of Pressure, Pirani Gauge, Potentiometric Pressure Transducer, Electrodynamic Pressure Transducer, Thermal Conductivity Gauge, Servo Pressure Transducer, Pressure Switch, IC,s for Pressure Measurement.	**04**	**10**
6	Flow Measurement: Introduction, Methods of Flow measurement, Turbine Flow Meter, Electro Magnetic Flow Meter, Hot Wire Anemometer, Ultrasonic Flow Meter, Vortex Flow Meter.	**03**	**10**
7	Level Measurement: Capacitive Sensors for Level Measurement, Ultrasonic Level Sensor, Radiation Level Detector, LASER Level Sensor, Optical Level Detector.	**03**	**10**
8	Temperature Measurement: RTD, Thermistor, Thermocouples, Types of Pyrometers, Solid State Sensors.	**05**	**15**
9	Development in Sensor Technology Semiconductor sensors, Smart Sensors, Micro sensors, IR radiation Sensors, Ultrasonic Sensors, Fiber optic Sensors, Chemical Sensors, Bio Sensors	**03**	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	**25**	**25**	**10**	**10**	**--**

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. Industrial Instrumentation & Control by S. K. Singh, 2nd Edition, TMH Publication
2. Instrumentation: Devices and Circuits by C. S. Rangan, G. R. Sharma, V. S. V. Mani, 2nd Edition,TMH Publication
3. Transducers and Instrumentation by DVS Murthy, 2nd Edition, PHI Learning P. Ltd
4. Electrical and Electronics Measurement and Instrumentation, By A.K. Shawney, Dhanpatrai & sons publications
5. Instrumentation measurement and analysis by Nakra Chaudhari, 3rd edition, TMH Publication
6. Fundamental of Industrial Instrumentation By Alok Barua, wiley India

Course Outcome:

After learning the course the students should be able to:

1. Explain various Sensors for measurement of various non electrical quantities.
2. Elaborate the applications of sensors to sense the non electrical quantity and its application in process instrumentation and automation.

List of Experiments:

Directions for Laboratory work:

1. The list of experiments is given as a sample.
2. As far as possible printed manual should be preferred so that students can concentrate in laboratory experiments and related study.

Minimum 10 experiments should be carried out.

1. To study the measurement of weight using Strain gauge.
2. To study the measurement of linear displacement using Linear Variable Differential Transformer (LVDT).
3. To Study the measurement and control of temperature using Resistance Temperature Detector (RTD).
4. To Study the measurement and control of temperature using Thermocouple.
5. To Study the measurement and control of temperature using Thermistor.
6. To study the measurement of flow using Ultrasonic Flow meter.
7. To study the measurement of speed using Decoder.
8. To study the measurement of torque.
9. To study the measurement of force using Piezoelectric transducer.
10. To study Measurement of flow using Electromagnetic flowmeter.

Design based Problems (DP)/Open Ended Problem:

To design signal processing circuits for various outputs of transducers like thermocouple linearization, cold junction compensation, resistance to voltage conversion etc.

Major Equipment:

Transducer trainers, Oscilloscope, Function Generator etc.

List of Open Source Software/learning website:

Learning website:

- http://nptel.iitm.ac.in/courses.php
- http://ocw.mit.edu
- http://www.electrical-engineering-portal.com
- http://www.datasheetcatalog.com
- http://www.ti.com
- http://www.national.com
- http://en.wikipedia.org
- https://www.omega.com
- http://www.transducersdirect.com

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.