GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION & CONTROL ENGINEERING (17)
INDUSTRIAL MEASUREMENT II
SUBJECT CODE: 2151707
B.E. 5th SEMESTER

Type of course: Core Engineering

Prerequisite: Basic principles and laws of physics

Rationale: Industrial Instrumentation is a unique part of industry that deals with the measuring of variables that influence materials production and equipment during the development of a product. Every Instrument engineers have to deal with various types of Instruments in the working environment. This course describes the working principles of these measuring instruments.

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		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Displacement Measurement** Pneumatic Transducers, electrical Transducers, Optical Transducers, Ultrasonic Transducers, Magnetostrictive Transducers, Digital Displacement Transducers, proximity Sensors	**8**	14
2.	**Strain Measurement** Stress-strain relations, Resistance strain gauges, Fiber-optic strain gauges	**12**	24
3	**Acceleration, Force and Torque Measurement** Acceleration measurement, Force measurement, Industrial weighing system, Torque measurement, Tachometers	**8**	14
4	**Miscellaneous Measurements** Humidity and Moisture measurement, Density measurement, Conductivity measurement, Oxidation-Reduction Potential, pH measurement, polarography, Viscosity measurement, Consistency measurement, Turbidity measurement, Opacity measurement	**12**	24
5	**Analytical Instrumentation** Industrial gas analysis, Chromatography, Mass spectrometer, Infrared analyser, UV-visible absorption spectrophotometer, X-ray methods, Radiation detectors, Sample handling systems	**12**	24

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
21	**21**	**14**	**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. Instrument Engineers' Handbook: Process Measurement and Analysis by B. G. Liptak.
2. Handbook of Applied Instrumentation by D. M. Considine and Sidney David Ross, McGraw – Hill
3. publication.
4. Encyclopedia of Instrumentation and Control by D. M. Considine, Krieger publication Co.
5. Instrumentation Reference Book by Walt Boyes, Butterworth – Heinemann publisher.
6. Introduction to Instrumentation and Control by A. K. Ghosh, 4th edition, PHI publications
7. Industrial Instrumentation by K. Krishnaswamy and S. Vijayachitra, New Age International Publication.
8. Measurement Systems: Application and Design by E. D. Doeblin, McGraw – Hill Publication.

Course Outcome:

1. After learning the course the students should be able to learn basic measurement principles of displacement, strain, acceleration, force, torque and other analytical parameters.
2. Students should be able to identify the type of sensor and their relevant specification .etc which can be used in a particular process parameter measurement selection.
3. Students should be able to communicate effectively in oral and written form while formulating project proposals for particular subjects, reports and other related documents.
4. Students should be able design and conduct experiments for measurement, characterization and able to analyze and interpret data.

List of Experiments:

1. Characterization and calibration of potentiometer based displacement sensor.
2. Characterization and calibration of LVDT as displacement sensor
3. Measurement of strain on a beam using strain gauge.
4. Determine the effect of temperature and electromagnetic interference on Strain Gauge and LVDT respectively.
5. Characterization and calibration of speed measurement system. (Tachometer, Photoelectric and magnetic Pick-up).
6. Characterization and calibration of vibration measurement system. (Piezo-resistive vibration pick-up)
7. Characterize the Proximity sensors (inductive) and study its behavior under environment under study.
8. Identify the absolute position of the shaft using encoders.
9. Study of the detectors (leak detectors, flame detectors, smoke detectors)
10. Case study based on applications of sensors used in auto industry
11. Case study based on applications of sensors used in process industry.
12. To find out transmittance and absorbance of a given sample using colorimeter.
13. To calibrate pH measurement system and to measure pH of given sample.
14. Qualitative and quantitative analysis using UV-Visible spectrophotometer.
15. Study of spectrophotometers.

16. To analyze a given water sample using turbidity meter, DO meter, hygrometer, etc.

Students should be taken for at least one industrial visit of medium scale/ large scale industry to give them exposure towards the topics discussed in the subject.

Design based Problems (DP)/Open Ended Problem: **Nil**

Major Equipment:

Universal calibrator, Temperature bath, Voltage/ current Simulator, Measurement set up for different parameters.

List of Open Source Software/learning website:

http://nptel.ac.in/video.php?subjectId=108105064

http://www.onlinevideolecture.com/electrical-engineering/nptel-iit-kharagpur/industrial-instrumentation/?course_id=514

https://www.isa.org

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.