

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CRYOGENIC ENGINEERING) (10) LOW TEMPERATURE MEASUREMENT AND INSTRUMENTATION SUBJECT CODE: 2721007 SEMESTER: II

Type of course: Major Elective III

Prerequisite: Basic knowledge of metrology, Instrumentation and control engineering

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
				ESE	OEP	PA	RP			
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Measuring Environment : Significance of measurement & Instrumentation, Measuring systems-- Transducers & Its Environment, The Nature of Measurement, Functional Stages of Measuring Systems ,Measuring problems, the instrumentation problems, Static & dynamic ,Characteristic of Instruments.	4	5
2	Transducers: Physical laws, Static characteristics ---Linear Characteristics, Common Non Linearity & Its Effect, Linearization, Transducer types & modelling, Calibration, Errors in measurement, Selection of alternative test methods.	4	10
3	Sensors: Electric Sensing devices, Magnetic sensors, Pressure sensors, Piezo-resistive sensors, Strain sensors, Temperature sensors, Fibreoptics sensors, Ultra violet detectors, Chemical sensors.	5	10
4	Level & Volume Measurement: Practice of level measurement, Calibration of level measuring Instruments, Methods of providing full range level measurement, Methods providing short range detection.	5	10
5	Density measurement : Measurement of density using weight, Measurement of density using buoyancy ,Measurement of density using hydrostatic head, Measurement of density using radiation	4	10
6	Flow Measurement: laminar flow and Turbulent flow, “Direct” flow measurement – Weighing ad volumetric Methods, Positive Displacement Methods, flow visualization, “carrier” systems “Indirect” flow measurement--square root law flow meters, Orifice and venture flow meters, Characteristics of Square rootlaw flow meters, Pitot static tubes, Variable Area flow meters, Drag Force flow meters, Turbine flow meters, ultrasonic flow meter, Electromagnetic flow meter, Impeller flow meter, Thermal mass flow	5	15

	meter		
7	Pressure & Sound Measurement : Pressure measurement, Vacuum measurement, Ultrasound measurement	4	10
8	Thermometry for low temperature : Gas thermometers, Vapor pressure thermometers, resistance thermometers, Thermocouples, 3He Melting Curve Thermometers, Noise thermometers, Superconducting Fixed point Thermometers, Nuclear Orientation thermometers, Mossbauer – Effect thermometers, Coulomb Blockade Thermometers, Osmotic pressure Thermometers, Infrared thermometers, Fibre– Optic Thermometers, Secondary thermometers.	5	15
9	Noise & Distortion: Electric Noise Measurement, Electric Distortion Measurement, Intermodulation measurement, Measurement of frequency, phase noise, and amplitude Noise.	3	5
10	Non destructive Testing : Introduction, Visual examination, surface inspection methods, ultrasonics, Radiography, Underwater non-destructive testing, Developments, Certification of Personnel	3	10

Reference Books:

1. Measurement and Instrumentation in Engineering by FRANCIS S. TSE
2. Survey of instrumentation and Measurement by Stephen A. Dyer
3. The measurement, Instrumentation, and Sensors, Handbook by John G. Webster
4. Low temperature physics & superconductivity by Christian Enss & Siegfried Hunklinge

Course Outcome:

After learning the course the students should be able to:

To Know about different types of pressure sensors, temperature sensors, mass flow rate measurement devices and density measurement

List of Tutorials:

1. Study of static and dynamic characteristics of the measuring instruments.
2. Study of different types of sensors & transducers.
3. Study and demonstration of level & volume measurement instruments.
4. Study of different methods of density measurement.
5. Study & Analysis of flow measurement devices.
6. Study of pressure measuring devices.
7. Study & analysis of temperature measuring devices for low temperature.
8. Study & demonstration of noise, frequency and distortion measurement.
9. study of Non – destructive testing methods.

Major Equipment:

Different temperature sensors like PT 100, thermocouples, pressure transducers, Gas flow meter, data requisition system

List of Open Source Software/learning website:

National instrument website and online courses

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website