



GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3721007

Semester – II

Subject Name: LOW TEMPERATURE MEASUREMENT AND INSTRUMENTATION

Type of course: Program Elective

Prerequisite: Basic knowledge of metrology, Instrumentation and control engineering

Rationale: The course is formulated to impart detailed study of cryogenic plants and equipments which can be utilized for the different cryogenic applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
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
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
3	Sensors: Electric Sensing devices, Magnetic sensors, Pressure sensors, Piezo- resistive sensors, Strain sensors, Temperature sensors, Fibre optics sensors, Ultra violet detectors, Chemical sensors.	5
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
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
6	Flow Measurement: laminar flow and Turbulent flow, “Direct” flow measurement – Weighing ad volumetric Methods, Positive Displacement Methods, flow visualization,	5



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	“carrier” systems “Indirect” flow measurement-square root law flow meters, Orifice and venture flow meters, Characteristics of Square root law 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 meter, Coriolis flow meter	
7	Pressure & Sound Measurement : Pressure measurement, Vacuum measurement, Ultrasound measurement	4
8	Thermometry for low temperature : Gas thermometers, Vapour 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
9	Noise & Distortion: Electric Noise Measurement, Electric Distortion Measurement, Intermodulation measurement, Measurement of frequency, phase noise, and amplitude Noise.	3
10	Non-destructive Testing : Introduction, Visual examination, surface inspection methods, ultrasonics, Radiography, Underwater non-destructive testing, Developments, Certification of Personnel	3

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	20	20	20	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. 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 Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To have the basic knowledge of working measuring cryogenic environment for selection of sensors and trasnducers	30



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CO-2	To select and use of different type of measurement instruments related with temperature, density, flow, volume etc. for cryogenic application	50
CO-3	To reduce the noise and distortion from the data collected by the measuring instrumentation for accuracy.	10
CO-4	To have the basic skills for the different testing methods of the cryogenic systems	10

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.

Equipment / Computational facility:

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