

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. Semester: III

Mechanical Engineering (Cryogenic Engineering)

Subject Name **LOW TEMPERATURE MEASUREMENT & INSTRUMENTATION**

Sr.No	Course content
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.
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.
3.	Sensors: Electric Sensing devices, Magnetic sensors, Pressure sensors, Piezo- resistive sensors, Strain sensors, Temperature sensors, Fibre optics sensors, Ultra violet detectors, Chemical sensors.
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.	Density measurement : Measurement of density using weight, Measurement of density using buoyancy ,Measurement of density using hydrostatic head, Measurement of density using radiation
6.	Flow Measurement: laminar flow and Turbulent flow, "Direct" flow measurement – Weighing and volumetric Methods, Positive Displacement Methods, flow visualization, "carrier" systems "Indirect" flow measurement--square root law flow meters, Orifice and venturi 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
7.	Pressure & Sound Measurement : Pressure measurement, Vacuum measurement, Ultrasound measurement
8.	Thermometry for low temperature : Gas thermometers, Vapor pressure thermometers, resistance thermometers, Thermocouples, ³ He 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.

9.	Noise & Distortion: Electric Noise Measurement, Electric Distortion Measurement, Intermodulation measurement, Measurement of frequency, phase noise, and amplitude Noise.
10.	Non destructive Testing : Introduction, Visual examination, surface inspection methods, ultrasonics, Radiography, Underwater non-destructive testing, Developments, Certification of personnel

List of Experiments:

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.

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 Hunklinger