

INSTRUMENTATION AND CONTROL SYSTEMS**B.Tech. IV Year I Sem.****L T/P/D C****Course Code: ME702PC/AM731PE****4 0/0/0 4**

Prerequisite: Mathematics-I, Thermodynamics, Basic of Electrical and electronic Engineering.

Course Objectives: Understanding the basic characteristic of a typical instrument. Identifying errors and their types that would occur in a instrument. Identifying properties used for evaluating the thermal systems. The concept of transducer and Various types and their characters.

Course Outcome: To identify various elements and their purpose in typical instruments, to identify various errors that would occur in instruments. Analysis of errors so as to determine correction factors for each an instrument. To understand static and dynamic characteristics of instrument and should be able to determine loading response time. For given range of displacement should be able to specify transducer, it accurate and loading time of that transducer.

UNIT – I

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics – sources of errors, Classification and elimination of errors.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

UNIT – II

Measurement of Temperature: Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals.

Measurement of Pressure: Different principles used- Classification: Manometers, Dead weight pressure gauge. Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, Mcleod pressure gauge.

UNIT – III

Measurement of Level: Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators – Bubbler level indicators.

Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed : Mechanical Tachometers, Electrical tachometers, Non- contact type-Stroboscope

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

UNIT – IV

Stress-Strain measurements : Various types of stress and strain measurements –Selection and installation of metallic strain gauges- electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.

Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter.

Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT – V

Elements of Control Systems:

Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems

TEXT BOOKS:

1. Principles of Industrial Instrumentation and Control Systems /Alavala / Cengage
2. Instrumentation, Measurement and Analysis/ B.C.Nakra and K.K.Choudhary/ Mc Graw Hill.

REFERENCE BOOKS:

1. Process Control Instrumentation Technology/ Curtis D. Johnson / Person
2. Mechanical Measurements / Sirohi and Radhakrishna / New Age International