

Semester –II, Paper -3
INSTRUMENTATION SYSTEM DESIGN

Teaching scheme:

Lecture: 4 hrs/week

Practical: 2hrs/week

Examination Scheme

Theory: 100 Marks

Term work: 25 Marks

Practical: 25 Marks

Unit 1.

(10 Hrs, 20 Marks)

Basic concepts of transducer design: General transducer design consideration, testing of transducer, and selection criteria of transducer.

Design of temperature measurement system based on RTD, Thermocouple and thermistors, Design of Displacement measurement system based using LVDT, Potentiometer, Ultrasonic transducer, Complete signal conditioning circuits for above temperature and Displacement transducers.

Unit 2.

(10 Hrs, 20 Marks)

Design of orifice, rotameter, venturi based flow system and signal conditioning circuits for above system. Design of level sensors and its signal conditioning circuits, design of pressure gauge, diaphragm based pressure gauge, Load cell and its signal conditioning, study of P/I and I/P converters, Design of smart transmitters

Unit 3.

(10 Hrs, 20 Marks)

Concept of reliability definition, Distinction between Quality and reliability, failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modeling Exponential, Weibull and Gamma Distribution, Hazard rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function and Reliability, function system Transition Diagrams and Markov Chain modeling concurrent and sequential systems. Component and Operational Modes. Reliability Prediction: Life Testing and Accelerated Life testing Burn-in and Initial Failure removal.

Unit 4.

(10 Hrs, 20 Marks)

Guidelines for enclosure: components and accessories, Grounding and shielding techniques noise in electronic circuits, EMI/ EMC protection against EMI, ESD selection of cables, connectors, types of knobs,; mechanical fixture PCB holders, clamps, control panel layout ergonomics, types of gear boxes and drives. Ingress protection authorized regulatory bodies for certifying instruments in Hazardous location (BASEEFA, FM, PTB, UL, CESI, LLIE, CSA, DEMKO, IEC & CENELEC).

Unit 5.

(10 Hrs, 20 Marks)

Printed circuit board design guidelines: general components layout scheme, grid system, PCB size mechanical stress, design rules for analog and digital circuit PCB, single, multi layer and SMD boards, Artwork CAD packages, soldering techniques.

References:

1. Electrostatic Discharge and Electronic Equipment, "Warren Boxleitner" IEEE presses.
2. Printed Circuit Boards, "Walter C. Bosshart", CEDT series, TMH.
3. Noise Reduction Techniques, "Ott".
4. Reliability Engineering, "E. Balguruswamy", PHI.
5. Applications of Analog Intergrated Circuit, "S. Soclof", PHI.
6. Process Control, "B.G.Liptak", Chilton.
7. National Instruments Catalog.
8. Measurement Systems, "E.O.Doeblin".
9. Process control and Instrumentation technology, "C. D, Johnson", PHI

List of Experiments:

1. Design of signal conditioning for displacement measurement transducer..
2. Design of signal conditioning RTD (Pt-100)
3. Design of signal conditioning for thermocouple
4. Study and Calibration of I/P & P/I converter
5. Study of D.P. Transmitter and its application for flow
6. Study of D.P. Transmitter and its application for level
7. Study of smart transmitter
8. Design of signal conditioning for load cell.
9. Study of Enclosure design for circuit and instrument.
10. Design of PCB on above any one signal conditioning application

Term work shall include minimum **eight** practicals from above list.