Core-III **Semester-II**

Electronic Instrumentation

Course Outcomes (COs)

- Explain the principles of electronic measurement and instrumentation, including the performance characteristics of different measurement systems.
- Identify the various parameters that are measurable in electronic instrumentation.
- Employ appropriate instruments to measure given sets of parameters.
- Design and evaluate complete measurement systems for various applications, considering factors such as performance, precision, and calibration.
- Practice the construction of testing and measuring set up for electronic systems.
- To have a deep understanding about instrumentation concepts.

Unit-1

- Qualities of Measurement: Specifications of instruments, their static and dynamic characteristics, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting.
- Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement - ammeter,
- voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating
- types), digital multimeters, digital frequency meter system (different modes and universal counter).
- Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc.

Unit-2

- Measurement of Resistance and Impedance: Low Resistance: Kelvin's double bridge method, Medium Resistance by Voltmeter Ammeter method, Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Hay's bridge, and Anderson's bridge, Measurement of Capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge.
- A-D and D-A Conversion: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Unit-3

- Oscilloscopes: CRT, wave form display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).
- Signal Generators: Audio oscillator, Pulse Generator, Function generators.

Unit-4

- Transducers and sensors: Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area Type – Variable Air Gap type –Variable Permittivity type), Inductive (LVDT) and piezoelectric transducers. Measurement of displacement, velocity and acceleration (translational and rotational). Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Suggested References:

- ✓ *1. H. S. Kalsi, Electronic Instrumentaion, TMH(2006)*
- ✓ *W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall (2005).*
- ✓ *Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH*
- ✓ *E.O.Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003).*
- ✓ *Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)*
- ✓ *David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).*
- ✓ *Oliver and Cage, ―Electronic Measurements and Instrumentation‖, TMH (2009).*
- ✓ *Alan S. Morris, ―Measurement and Instrumentation Principles‖, Elsevier (Buterworth Heinmann-2008).*
- ✓ *A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpatRai and Sons (2007).*
- ✓ *C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).*

Practical

1. Design of multi range ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
3. Measurement of Capacitance by de‘Sautys.
4. Measure of low resistance by Kelvin‘s double bridge.
5. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
6. To determine the Characteristics of LVDT.
7. To determine the Characteristics of Thermistors and RTD.
8. Measurement of temperature by Thermocouples and study of transducers like AD590 (two terminal temperature sensor), PT-100, J- type, K-type.
9. To study the Characteristics of LDR, Photodiode, and Phototransistor:
10. (i) Variable Illumination.
    (ii) Linear Displacement.
11. Characteristics of one Solid State sensor/ Fiber optic sensor