

**COURSE TITLE** : ELECTRONICS INSTRUMENTS AND MEASUREMENTS  
**COURSE CODE** : 4041  
**COURSE CATEGORY** : A  
**PERIODS/WEEK** : 4  
**PERIODS/SEMESTER** : 56/4  
**CREDITS** : 4

**TIME SCHEDULE**

| MODULE       | TOPIC   | PERIODS   |
|--------------|---|-----------|
| 1            | Analog and digital meters                     | 14        |
| 2            | Analog and digital oscilloscopes, transducers | 14        |
| 3            | Bridges and signal analysers                  | 14        |
| 4            | Data recorders and DAS                        | 14        |
| <b>TOTAL</b> |   | <b>56</b> |

Course General Outcome :

| Module | GO | On completion of the study of this course the students will be able:        |
|--------|----|---|
| 1      | 1  | To understand the performance of various measuring instruments.             |
|        | 2  | To understand working and use of analog and digital multimeters.            |
| 2      | 3  | To understand working and use of analog and digital oscilloscope.           |
|        | 4  | To understand different types of transducers, sensors and its applications. |
| 3      | 5  | To understand various AC and DC bridges.                                    |
|        | 6  | To understand the working of function generators and signal generators.     |
| 4      | 7  | To understand various types of data recorders.                              |
|        | 8  | To understand the basics of data acquisition system.                        |

*GO - General Outcome*

On the completion of the study the student will be able :

## **MODULE I ANALOG AND DIGITAL MULTIMETERS**

### **1.1.0 To understand the performance of various measuring instruments.**

- 1.1.1 To define instrument accuracy, precision, sensitivity, resolution and error.
- 1.1.2 To explain the working of galvanometer.
- 1.1.3 To explain the conversion of galvanometer into voltmeter and ammeter.
- 1.1.4 To list the differences between moving coil and moving iron instruments.

### **1.2.0 To understand working and use of analog and digital multimeters.**

- 1.2.1 To explain the block diagram of Analog Multimeter.
- 1.2.2 To explain how Galvanometer is converted into Multimeter.
- 1.2.3 To list the specifications of Analog Multimeter .
- 1.2.4 To explain how the Analog Multimeter to measure different values of resistances.
- 1.2.5 To explain the DC voltage and DC Current Measuring circuit in Analog Multimeter.
- 1.2.6 To explain the AC voltage and AC Current Measuring Circuit in Analog Multimeter.
- 1.2.7 To explain the Block Diagram of Digital Frequency Meter.
- 1.2.8 To list the specifications of Digital Multimeter.
- 1.2.9 To explain Block Diagram Digital Multimeter.
- 1.2.10 To differentiate 3 ½ and 4 ½ digit displays in terms of accuracy.

## **MODULE II ANALOG AND DIGITAL OSCILLOSCOPES, TRANSDUCERS.**

### **2.1.0 To understand working and use of analog and digital oscilloscope.**

- 2.1.1 To list the applications of CRO.
- 2.1.2 To explain the functional block diagram of a CRO.
- 2.1.3 To explain CRT with neat sketch.
- 2.1.4 To explain electrostatic focusing and deflection system used in CRT. .To state the deflection sensitivity.
- 2.1.5 To describe different types of CRO probes.
- 2.1.6 To describe the procedures of measuring voltage (DC and AC), frequency, phase. Angle and time period using CRO.
- 2.1.7 To differentiate between dual beam and dual trace CROs.
- 2.1.8 To explain the working of digital storage oscilloscope.

### **2.2.0 To understand different types of transducers, sensors and its applications.**

- 2.2.1 To list the classification of transducers.
- 2.2.2 To describe different types of resistive transducers - potentiometric, strain gauge and thermistors.
- 2.2.3 To explain the working principle of capacitive transducers.
- 2.2.4 To explain the working principle of microphone type transducer.
- 2.2.5 To explain the working principle of LVDT.
- 2.2.6 To explain the principle of thermocouple, thermopile and opto coupler.
- 2.2.7 To explain the features of photo voltaic cell with application and examples.

- 2.2.8 To describe sensors and actuators, different switches, relays, proximity switches, hall effect sensor and fiber-optic sensor.

### **MODULE III BRIDGES AND SIGNAL ANALYSERS.**

#### **3.1.0 To understand various AC and DC bridges.**

- 3.1.1 To explain resistance measurement using Wheatstone bridge.  
3.1.2 To explain the principle of impedance measurement using Hay's bridge.  
3.1.3 To explain the principle of impedance measurement using Maxwell's bridge.  
3.1.4 To explain the principle of impedance measurement using Schering's bridge.  
3.1.5 To describe the principle of measuring frequency using Wien bridge.

#### **3.2.0 To understand the working of function generators and signal generators.**

- 3.2.1 To explain the block diagram of function generator.  
3.2.2 To explain the principle and block diagram of a spectrum analyzer.  
3.2.3 To list the applications of spectrum analyzer.  
3.2.4 To explain the block diagram of logic analyzer.  
3.2.5 To list the applications of logic analyzer.  
3.2.6 To explain the principle of Q-meter.

### **MODULE IV DATA RECORDERS AND DAS**

#### **4.1.0 To understand various types of data recorders.**

- 4.1.1 To understand the principle of data recorders.  
4.1.2 To explain the working of potentiometer type recorders.  
4.1.3 To explain the working of X-Y recorders, and strip chart recorders.  
4.1.4 To compare different types of data recorders.

#### **4.2.0 To understand the basics of data acquisition system.**

- 4.2.1 To explain the block diagram of basic instrumentation systems.  
4.2.2 To differentiate open loop and closed loop control systems.  
4.2.3 To list different types of DAS.  
4.2.4 To explain the block diagram of analog DAS.  
4.2.5 To explain the block diagram of digital DAS.  
4.2.6 To describe the role of telemetry in instrumentation system.

## CONTENT DETAILS

### **MODULE I Analog and Digital Multimeters**

Terminologies in measurements - accuracy - precision - sensitivity - resolution - error - galvanometer - working - conversion of galvanometer into voltmeter and ammeter - differences between moving coil and moving iron instruments - analog multimeter - block diagram - use of galvanometer as multimeter - measuring circuit for measurement of resistance, dc current, dc voltage, ac current and ac voltage - specifications - digital frequency meter - digital multimeter - block diagram - difference between 3 ½ and 4 ½ digit displays in terms of accuracy.

### **MODULE II Analog and Digital Oscilloscopes, Transducers**

CRO - applications - functional block diagram, CRT - construction - electrostatic focusing and deflection system - deflection sensitivity - types of CRO probes - measurement of voltage (DC and AC), frequency, phase angle and time period with CRO - difference between dual beam and dual trace CROs - digital storage oscilloscope - block diagram - working principle - transducers - classification - primary and secondary - active and passive, types of resistive transducers - potentiometric, strain gauge and thermistors, capacitive transducers, microphone type transducer, LVDT, thermocouple, thermopile, opto coupler - working principle - photo voltaic cell - features - application - examples - sensors - actuators - different switches - relays - proximity switches - hall effect sensor - fiber-optic sensor.

### **MODULE III Bridges and Signal Analysers**

Wheatstone bridge - Hay's bridge - Maxwell's bridge - Schering's bridge - impedance measurement - Wien bridge - frequency measurement - function generator - block diagram - spectrum analyzer - principle - block diagram - applications - logic analyzer - block diagram - applications - Q-meter - working principle

### **MODULE IV Data Recorders and DAS**

Data recorders - potentiometer type recorders - X-Y recorders - strip chart recorders - working principle - comparison - basic instrumentation systems - block diagram - difference between open loop and closed loop control systems - types of DAS - analog DAS - digital DAS - block diagram - role of telemetry in instrumentation system

### **Text Book**

1. Electronic Instrumentation - H S Kalsi - Third edition.
2. Electronics and Electrical Measurements and Instrumentation - J B Gupta - S K Kataria.
3. A Course in Electrical and Electronic Measurements and Instrumentation - A K Sawhney.
4. Industrial Electronics and Control - Biswanath Paul.