ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Classification of instrument systems

Primary (Absolute) instruments

- The value of the electrical quantity in terms of absolute quantities (or some constants) of the instruments and their deflections.
- Not used in laboratories
- Maintained by national laboratories & similar institutions
- EXP: Tangent galvanometer, Absolute electrometer.

Secondary instruments

- Direct reading instruments
- Determined from the deflection of the instruments

EXP: ammeters, voltmeter, wattmeter, energy meter (watt-hour meter), ampere-hour meters

Deflecting Type Instruments

- Deflection of the instrument provides a basis for determining the quantity under measurement.
- The measured quantity produces some physical effect which deflects or produces a mechanical displacement of the moving system of the instrument.
- An opposing effect is built in the instrument which tries to oppose the deflection or the mechanical displacement of the moving system.
- PMMC ammeter the deflection of moving coil is proportional to I i.e. the quantity under measurement.
- $Td = GI$

Where Td = torque developed on moving coil

G = constant dependent upon flux density, number of turns and area of moving coil

Null Type Instruments

- A zero or null indication leads to determination of the magnitude of measured quantity.
- The operation of a null type of instrument the following are required:
- The effect produced by measured quantity
- Opposing effect, whose value is accurately known,
- Detector detects the null conditions i.e. a device which indicates zero deflection when the effect produced by the measured quantity is equal to the effect produced by the opposing quantity.

Characteristics of instruments & measurement systems

Static Characteristics

- Some applications involve the measurement of quantities that are either constant or varies slowly with time.
- Under these circumstances it is possible to define a set of criteria that gives a meaningful description of quality of measurement without interfering with dynamic descriptions that involve the use of differential equations.
- These criteria are called static characteristics.

Dynamic Characteristics:

- Many measurements are concerned with rapidly varying quantities and therefore
- For such cases we must examine the dynamic relations which exist between the output and the input. This is normally done with the help of differential equations.
- Performance criteria based upon dynamic relations constitute the dynamic characteristics.

Static Characteristics

- **Accuracy: D**egree of closeness of the measured value to its true value.
- **Precision/repeatability/reproducibility:** Precision is a term that describes an instrument's degree of freedom from random errors.
- **Repeatability** describes the closeness of output readings
- **Tolerance** is a term that is closely related to accuracy and defines the maximum error that is to be expected in some value.