

UNIT I

CHARACTERISTICS OF INSTRUMENTS

These performance characteristics of an instrument are very important in their selection.

Static Characteristics:

Static characteristics of an instrument are considered for instruments which are used to measure an unvarying process condition. Performance criteria based upon static relations represent the static Characteristics. (The static characteristics are the value or performance given after the steady state condition has reached).

Dynamic Characteristics:

Dynamic characteristics of an instrument are considered for instruments which are used to measure a varying process condition. Performance criteria based upon dynamic relations represent the dynamic Characteristics.

STATIC CHARACTERISTICS

1) Accuracy

Accuracy is defined as the degree of closeness with which an instrument reading approaches to the true value of the quantity being measured. It determines the closeness to true value of instrument reading. Accuracy is represented by percentage of full scale reading or in terms of inaccuracy or in terms of error value. Example, Accuracy of temperature measuring instrument might be specified by $\pm 3^\circ\text{C}$. This accuracy means the temperature reading might be within + or - 3°C deviation from the true value. Accuracy of an instrument is specified by $\pm 5\%$ for the range of 0 to 200°C in the temperature scale means the reading might be within + or -10°C of the true reading.

2) Precision

Precision is the degree of repeatability of a series of the measurement. Precision is measures of the degree of closeness of agreement within a group of measurements are repeatedly made under the prescribed condition. Precision is used in measurements to describe the stability or reliability or the reproducibility of results.

Comparison between accuracy and precision:

Accuracy	Precision
It refers to degree of closeness of the measured value to the true value	It refers to the degree of agreement among group of readings
Accuracy gives the maximum error that is maximum departure of the final result from its true value	Precision of a measuring system gives its capability to reproduce a certain reading with a given accuracy

3) Bias

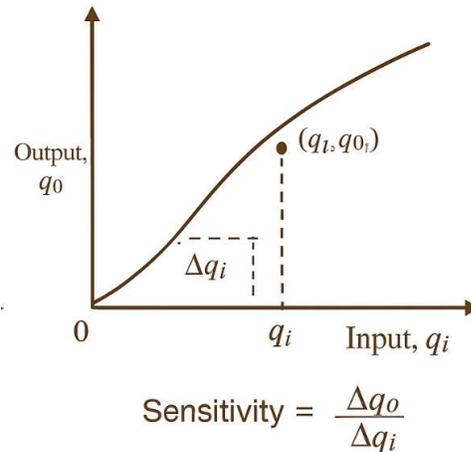
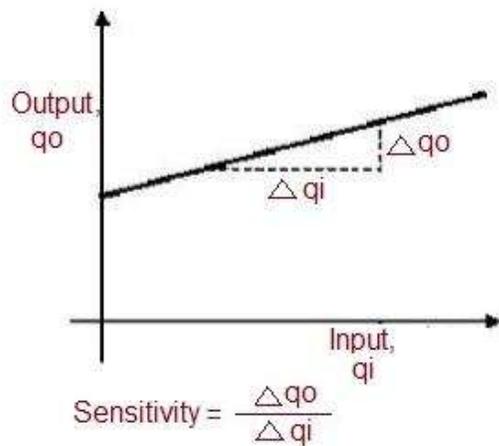
Bias is quantitative term describing the difference between the average of measured readings made on the same instrument and its true value (It is a characteristic of measuring instruments to give indications of the value of a measured quantity for which the average value differs from true value).

4) Sensitivity

Sensitivity is defined as the ratio of change in output signal (response) to the change in input signal (measurand). It is the relationship indicating how much output changes when input changes.

$$\text{Sensitivity} = \frac{\text{change in output}}{\text{change in input}}$$
$$\text{Sensitivity} = \frac{\Delta q_o}{\Delta q_i}$$

If the sensitivity is constant then the system is said to be linear system. If the sensitivity is variable then the system is said to be non-linear system.



When the calibration curve is linear as in figure 3a the sensitivity of the instrument can be defined as in slope of the calibration curve. In this case sensitivity is constant over the entire range of instrument. If the curve is not normally straight line or nonlinear instrument sensitivity varies with the input or varies from one range to another as in figure 3b.

4) Linearity

Linearity is the best characteristics of an instrument or measurement system. Linearity of the instrument refers to the output is linearly or directly proportional to input over the entire range

of instrument. So the degree of linear (straight line) relationship between the output to input is called as linearity of an instrument.

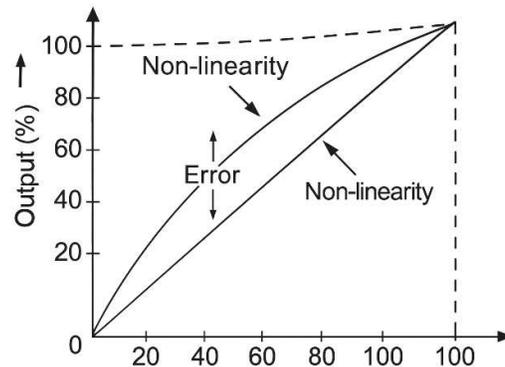


Fig.4: Representation of Linearity and Non-Linearity of an Instrument

Non-linearity:

The maximum difference or deviation of output curve from the Specified idealized straight line as shown in figure 4. Independent nonlinearity may be defined as

$$\text{Non linearity} = \frac{\text{Maximum deviation of output from the idealized straight line}}{\text{Actual reading or response}} \times 100$$

5) Resolution

Resolution or Discrimination is the smallest change in the input value that is required to cause an appreciable change in the output. (The smallest increment in input or input change which can be detected by an instrument is called as resolution or discrimination)

6) Hysteresis

Hysteresis is Non-coincidence of loading and unloading curves on output. Hysteresis effect shows up in any physical, chemical or electrical phenomenon. When input increases, output also increases and calibration curve can be drawn. If input is decreases from maximum value and output also decreases but does not follow the same curve, then there is a residual output when input is zero. This phenomenon is called Hysteresis. The difference between increasing change and decreasing change of output values is known as hysteresis error as shown in figure 5.(The different outputs from the same value of quantity being measured are reached by a continuously increasing change or a continuously decreasing change)

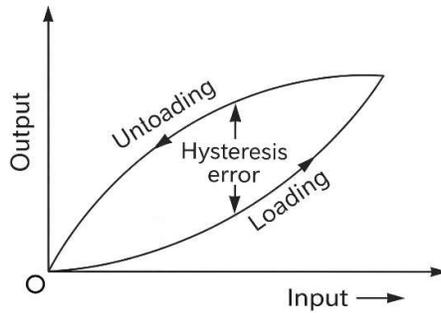


Fig. 5: Hysteresis Error of an instrument

7) Dead Zone

Dead zone or dead band is defined as the largest change of input quantity for which there is no output the instrument due the factors such as friction, backlash and hysteresis within the system. (The region upto which the instrument does not respond for an input change is called dead zone).Dead time is the time required by an instrument to begin to respond to change in input quantity.

8) Backlash

The maximum distance through which one part of the instrument is moved without disturbing the other part is called as backlash. (Backlash may be defined as the maximum distance or angle through which any part of the instrument can be moved without causing any motion of next part of the system)

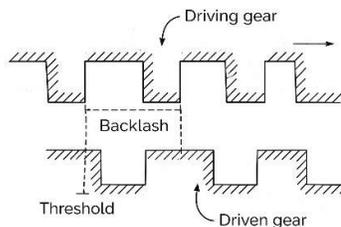


Fig. 6: Threshold because of backlash

Reasons for the presence of backlash in an instrument include allowing for lubrication, manufacturing errors, deflection under load, and thermal expansion.

9) Drift

Drift is an undesirable change in output over a period of time that is unrelated to change in input, operating conditions. Drift is occurred in instruments due to internal temperature variations, ageing effects and high stress etc.

Zero drift is used for the changes that occur in output when there is zero output.

It is expressed as percentage of full range output.

10) Threshold

The minimum value of input which is necessary to activate an instrument to produce an output is termed its threshold as shown in figure 7. (Threshold is the minimum value of the input required to cause the pointer to move from zero position).

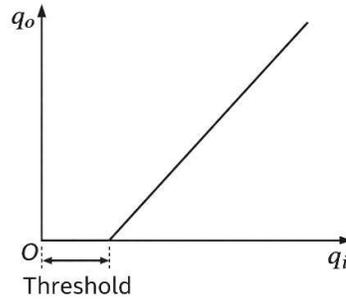


Fig. 7 Threshold effect

11) Input Impedance

The magnitude of the impedance of element connected across the signal source is called Input Impedance. Figure 8 shows a voltage signal source and input device connected across it.

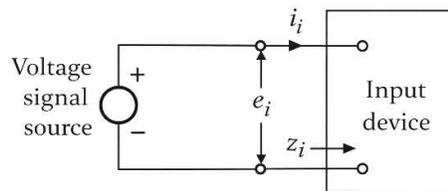


Fig. 8 voltage source and input device

The magnitude of the input impedance is given by

$$Z_i = \frac{e_i}{i_i}$$

Power extracted by the input device from the signal source is

From above two expressions it is clear that a low input impedance device connected across the

$$P = e_i i_i = \frac{e_i^2}{Z_i}$$

voltage signal source draws more current and more power from signal source than high input impedance device.

12) Loading Effect

Loading effect is the incapability of the system to faithfully measure, record or control the input signal in accurate form.

13) Repeatability

Repeatability is defined as the ability of an instrument to give the same output for repeated applications of same input value under same environmental condition.

14) Reproducibility

Reproducibility is defined as the ability of an instrument to reproduce the same output for repeated applications of same input value under different environment condition. In case of perfect reproducibility the instrument satisfies no drift condition.

15) Static Error

The difference between the measured value of quantity and true value (Reference Value) of quantity is called as Error.

Error = Measured value - True

Value $\delta A = A_m - A_t$

δA - error

A_m - Measured value of quantity

A_t - True value of quantity

16) Static Correction

It is the difference between the true value and the measurement value of the quantity

$\delta C = A_t - A_m = -\delta A$

δC - Static correction

17) Scale Range

Scale range is defined as the interval between the **lowest and highest values** that an instrument can measure.

Example:

For a thermometer with a scale from **-40°C to 100°C**, the **scale range** is **-40°C to 100°C**.

18) Scale Span

Scale span is defined as the **numerical difference between the maximum and minimum scale values** of an instrument.

Example:

For the same thermometer:

Maximum value = 100°C

Minimum value = -40°C

$$\text{Scale span} = 100 - (-40) = 140^\circ\text{C}$$

DYNAMIC CHARACTERISTICS

The dynamic behaviour of an instrument is determined by applying some standard form of known and predetermined input to its primary element (sensing element) and then studies the output. Generally dynamic behaviour is determined by applying following three types of inputs.

1. **Step Input:** Step change in which the primary element is subjected to an instantaneous and finite change in measured variable.
2. **Linear Input:** Linear change, in which the primary element is, follows a measured variable, changing linearly with time.
3. **Sinusoidal input:** Sinusoidal change, in which the primary element follows a measured variable, the magnitude of which changes in accordance with a sinusoidal function of constant amplitude.

The dynamic characteristics of an instrument are

- (i) Speed of response
- (ii) Fidelity
- (iii) Lag
- (iv) Dynamic error

(i) Speed of Response

It is the rapidity with which an instrument responds to changes in the measured quantity.

(ii) Fidelity

It is the degree to which an instrument indicates the changes in the measured variable without dynamic error (faithful reproduction or fidelity of an instrument is the ability of reproducing an input signal faithfully (truly).

(iii) Lag

It is the retardation or delay in the response of an instrument to changes in the measured variable. The measuring lags are two types:

Retardation type: In this case the response of an instrument begins immediately after a change in measured variable is occurred.

Time delay type: In this case the response of an instrument begins after a dead time after the application of the input quantity.

(iv) Dynamic Error

Error which is caused by dynamic influences acting on the system such as vibration, roll, pitch or linear acceleration. This error may have an amplitude and usually a frequency related to the environmental influences and the parameters of the system itself.

Errors in measurement:

Definition

- ❖ Error is the difference between the measured value and the true (actual) value of a quantity.
- ❖ It shows how much the measurement deviates from accuracy.

Types of Errors

1. Gross Errors

- Occur due to human mistakes.
- Examples:
 - ✚ Misreading the instrument scale.
 - ✚ Wrong recording of observations.
 - ✚ Using the instrument improperly.
- Can be reduced by:
 - ✚ Taking repeated readings.
 - ✚ Using proper measuring techniques.

2. Systematic Errors

- These errors are **consistent and predictable**.
- They occur due to **faults in instruments, environment, or method of measurement**.

a) Instrumental Errors

- Caused by **defects in the instrument**.

- Examples:
 - ✚ Zero error.
 - ✚ Worn-out parts.
 - ✚ Calibration error.

b) Environmental Errors

- Due to **external conditions**.
- Examples:
 - ✚ Temperature changes.
 - ✚ Humidity.
 - ✚ Pressure.
 - ✚ Magnetic fields.

c) Observational Errors

- Occur due to **limitations of the observer**.
- Examples:
 - ✚ Parallax error while reading analog scales.
 - ✚ Reaction time error.

d) Systematic Operational Errors

- Caused by **wrong measurement procedure**.
- Example:
 - ✚ Improper use of measuring instruments.

3. Random Errors

- Occur due to **unpredictable variations** in measurement.
- Not constant; they vary with each reading.
- Caused by:
 - ✚ Small, uncontrollable fluctuations in atmospheric conditions.
 - ✚ Noise and vibration.
- Can be reduced by:
 - ✚ Taking multiple readings and using average value.

4. Absolute Error

- Difference between the **measured value** and the **true value**.
- $|\text{Measured value} - \text{True value}|$

5. Relative Error

- Ratio of **absolute error** to the **true value**.
- Shows error size in comparison to actual value.

6. Percentage Error

- $\text{Relative error} \times 100$.
- Used to express error in **percent form**.

7. Limiting Error

- Maximum possible error specified by the manufacturer.
- Used to determine worst-case error in instruments.

8. Ways to Minimize Errors

- Proper calibration of instruments.
- Use of high-quality measuring devices.
- Maintaining stable environmental conditions.
- Taking repeated measurements.
- Avoiding parallax errors.
- Using correct measurement techniques.

Dynamic Characteristics

Definition

- ❖ These characteristics describe how an instrument behaves when measuring a time-varying (changing) quantity.
- ❖ They show how quickly and accurately an instrument follows changes in the input signal.

1. Speed of Response

- ❖ It tells how fast the instrument responds to a change in the input.
- ❖ Indicates the quickness of the output reaching its final value after the input changes.
- ❖ High speed of response = instrument is fast and sensitive to sudden changes.
- ❖ Examples of fast-response instruments:
 - ✚ Digital multimeter
 - ✚ Oscilloscope

2. Lag

- ❖ Lag means a delay in the response of the instrument.
- ❖ The instrument output takes time before it starts to follow the input change.
- ❖ Caused by:
 - ✚ Mechanical inertia
 - ✚ Electrical or thermal time constants
- ❖ More lag → slow measurement, late indication.
- ❖ Example:
 - ✚ Pointer-type analog meters show lag when measuring fast-changing signals.

3. Dynamic Error (Measurement Error During Changes)

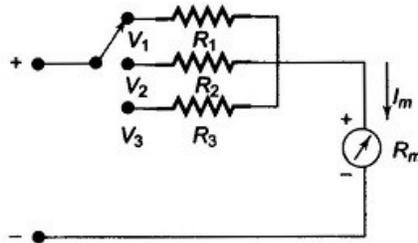
- ❖ The difference between the true value of a time-varying quantity and the indicated value at any instant.
- ❖ Occurs when the input changes faster than the instrument can follow.
- ❖ Also called time-dependent error.
- ❖ Dynamic error increases when:
 - ✚ Input changes very quickly
 - ✚ Instrument has low speed of response
 - ✚ Instrument has large lag

Conclusion

- ❖ Speed of Response → How fast the instrument reacts.
- ❖ Lag → Delay in starting the response.
- ❖ Dynamic Error → Error due to inability to follow rapid input changes.

Voltmeter

Multi-Range Voltmeter (Switch Selecting Individual Resistors)



Multirange Voltmeter

This circuit lets one voltmeter measure several voltage ranges (V_1, V_2, V_3) using different multiplier resistors (R_1, R_2, R_3).

1. Meter Movement (R_m & I_m)

- The meter has internal resistance R_m .
- It needs a small current I_m for full-scale deflection (FSD).

2. Multiplier Resistors (R_1, R_2, R_3)

- These resistors are connected in parallel with the switch.
- Each resistor corresponds to a different measuring range.

3. Range Selector Switch

- The switch selects the required voltage range.
- When switched to:
 - $V_1 \rightarrow R_1$ is used
 - $V_2 \rightarrow R_2$ is used
 - $V_3 \rightarrow R_3$ is used

4. Working Principle

- The selected resistor is placed in series with the meter.
- Most of the voltage drops across that resistor.
- Only a small, safe voltage reaches the meter.

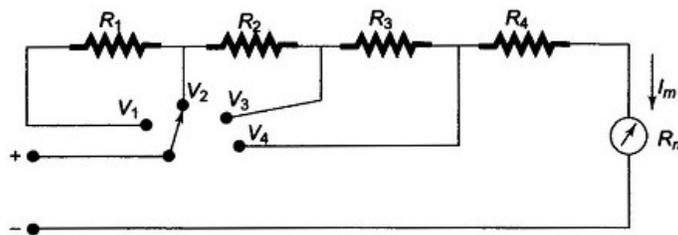
5. Different Resistors

- Higher voltage range \rightarrow larger multiplier resistor.
- Lower voltage range \rightarrow smaller multiplier resistor.

6. Output

- The same meter can measure multiple voltage levels by selecting the proper series

Multi-Range Voltmeter (Series String Arrangement)



Multipliers connected in series string

1. Resistors Connected in Series (R_1, R_2, R_3, R_4)

- All resistors are connected in series forming a resistor chain.
- Total resistance increases from left to right.

2. Selector Switch Taps (V_1, V_2, V_3, V_4)

- The switch selects different points in the resistor chain.
- When selecting:

- ✚ $V_1 \rightarrow$ Only R_1 is in series
- ✚ $V_2 \rightarrow R_1 + R_2$
- ✚ $V_3 \rightarrow R_1 + R_2 + R_3$
- ✚ $V_4 \rightarrow R_1 + R_2 + R_3 + R_4$

3. Voltage Range Control

- Higher tap (V_4) uses more resistance \rightarrow measures higher voltage.
- Lower tap (V_1) uses less resistance \rightarrow measures lower voltage.

4. Meter Movement (R_m and I_m)

- The meter again has internal resistance R_m and current requirement I_m .
- The voltage across the meter is kept within safe limits.

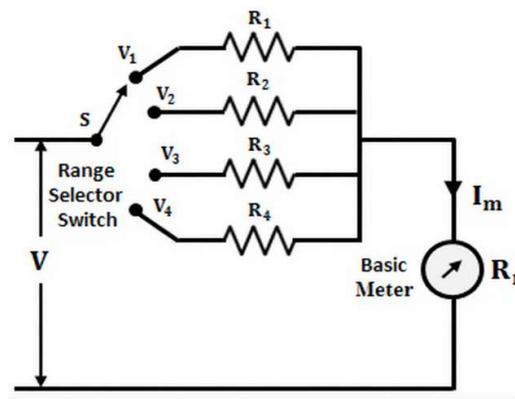
5. Working Principle

- The more resistors included in series, the larger the voltage the voltmeter can measure.
- The selector switch decides how much of the resistor chain is included.

6. Uses of Series String

- Only one switching point is needed per voltage range.
- Provides smooth range extension.
- Offers better accuracy because all resistors share a common reference point.

Range Extension of Voltmeter



Extension of Voltmeter Range

Basic Meter Movement (R_m , I_m)

- The instrument contains a sensitive meter movement.
- It has an internal resistance R_m .
- It requires a small current I_m (full-scale deflection current) to produce maximum pointer deflection.
- Because I_m is very small, the meter alone can measure only very low voltages.

Need for Multiplier Resistors

- To measure higher voltages safely, series resistors are added.
- These resistors are called multiplier resistors because they increase the voltage range.
- In the diagram, the multiplier resistors are R_1, R_2, R_3, R_4 .

Range Selector Switch (S)

- A switch is used to select the required voltage range.

- The switch connects the input voltage V to one resistor at a time.
- Switching positions:
 - ✚ $V_1 \rightarrow R_1$
 - ✚ $V_2 \rightarrow R_2$
 - ✚ $V_3 \rightarrow R_3$
 - ✚ $V_4 \rightarrow R_4$

Working

- When measuring a specific voltage range, the selected resistor is placed in series with the meter movement.
- The selected resistor takes most of the voltage drop, protecting the meter.
- Only a small voltage remains across the meter such that the current through it is I_m .

Example:

- For a high voltage range (V_4), the largest resistor R_4 is used.
- For a low range (V_1), the smallest resistor R_1 is used.

Thus, different resistors create different measurement ranges.

Formula for Each Multiplier Resistor

$$R_s = \left(\frac{V}{I_m} \right) - R_m$$

Where:

R_s = series multiplier resistor

V = desired voltage range

I_m = full-scale deflection current

R_m = internal resistance of meter

This formula ensures that the meter receives exactly the current I_m when the full-range voltage V is applied.

Purpose of the Multi-Range Arrangement

- Allows one meter to measure several voltage ranges.
- Protects the sensitive meter movement from high voltages.
- Makes the voltmeter economical, compact, and versatile.
- Easy range changing using the selector switch.

Feature	Multi-Range Voltmeter	Range Extension
Purpose	To measure multiple voltage ranges with one instrument	To increase a single range to a higher value
Construction	Several multiplier resistors + selector switch	One multiplier resistor added
Flexibility	High (many ranges)	Limited (only one extended range)
Complexity	More complex	Simple
Switch type	Selects one resistor at a time	Selects taps along a resistor chain
Connection	Individual resistors	Series resistor string

Number of resistors in each range	One	Several in combination
Advantage	Simple	More accurate and flexible
Use	General-purpose lab instruments	Extending basic meter movement

By changing the multiplier resistor using the switch, the same meter movement can be used to measure different voltage levels safely and accurately.

Ammeters:

Definition:

- An ammeter is an instrument used to measure electric current in a circuit.
- It is always connected in series with the load.
- It has very low internal resistance so that it does not affect the circuit current

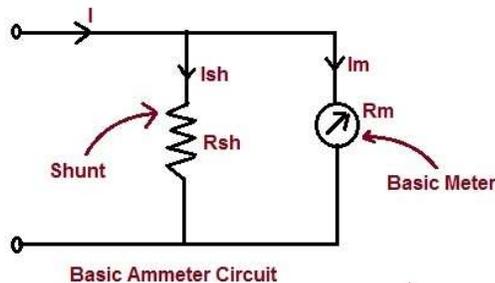
Shunt Type Ammeter:

A shunt type ammeter is an instrument in which a low-value resistor called a shunt is connected in parallel with a basic PMMC meter movement to enable the measurement of large currents without damaging the meter.

Need for Shunt Ammeter:

- The basic meter movement (PMMC) can carry only a small current, usually in the milliamperes (mA) range.
- To measure large currents, a low-resistance shunt is connected in parallel with the meter.
- The shunt provides an alternate path for the current.
- Most of the current flows through the shunt, while only a small, safe current flows through the meter.
- This arrangement protects the meter movement and allows accurate measurement of high currents.

Circuit Diagram:



Shunt Type Ammeter

Construction:

- The shunt type ammeter consists of a basic PMMC (Permanent Magnet Moving Coil) meter movement.

- A low-value resistor called shunt (R_{sh}) is connected in parallel with the meter movement.
- The meter movement has an internal resistance R_m and carries only a small current I_m .
- The shunt resistor is made of low-temperature-coefficient material (manganin or constantan) to maintain accuracy.
- The ammeter terminals are connected such that the entire current to be measured passes through the ammeter.
- Proper calibration is done so that the meter scale indicates the total current flowing in the circuit.

Working:

- When the ammeter is connected **in series** with the circuit, the total current I enters the ammeter.
- This current divides into two parts:
 - I_m flowing through the meter movement
 - I_{sh} flowing through the shunt resistor
- Since the shunt resistance is very small, most of the current flows through the shunt.
- Only a small, safe current flows through the PMMC meter, preventing damage.
- The voltage across the meter and shunt is the same, as they are connected in parallel:

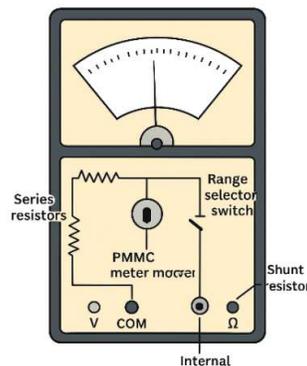
$$I_m R_m = I_{sh} R_{sh}$$

- The deflection of the meter is proportional to I_m , and the scale is calibrated to indicate the total current I .
- Thus, large currents can be measured accurately using a sensitive meter.
- A shunt type ammeter enables measurement of **high currents** by diverting excess current through a shunt.
- It provides protection, accuracy, and reliable current measurement

Multimeter for Voltage, Current and Resistance Measurements:

Definition:

- A multimeter is a single measuring instrument used to measure voltage (V), current (I) and resistance (R).
- It combines the functions of a voltmeter, ammeter and ohmmeter



Construction

- The multimeter consists of a PMMC (Permanent Magnet Moving Coil) meter movement, which acts as the basic indicating instrument.
- Series resistors are connected with the PMMC movement to enable voltage measurement and to extend voltage ranges.
- Shunt resistors of low resistance are connected in parallel with the meter movement for current measurement.
- A range selector switch is provided to select the required function (V, I or R) and appropriate range.
- An internal battery is included for resistance (ohmmeter) measurements.
- The instrument has input terminals such as:
 - ❖ V for voltage measurement
 - ❖ COM as common terminal
 - ❖ Ω for resistance measurement

- All components are enclosed in a compact casing with a calibrated scale.

Working

a) Voltage Measurement

- The multimeter is connected in parallel with the circuit.
- The range selector switch connects suitable series resistors with the PMMC movement.
- These resistors limit the current through the meter.
- The pointer deflection is proportional to the applied voltage.

b) Current Measurement

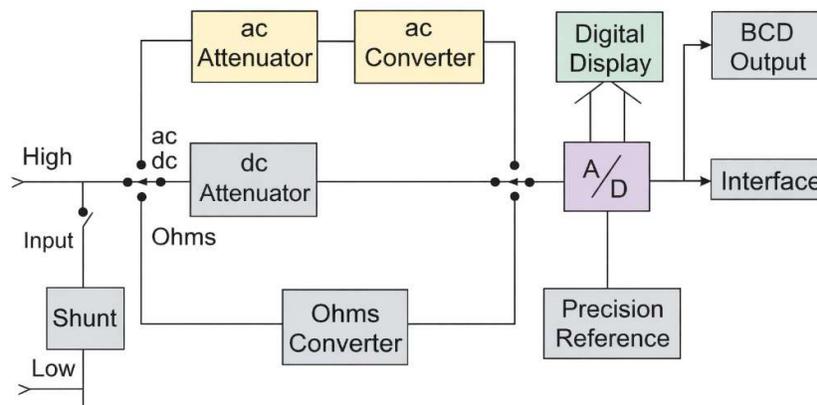
- The multimeter is connected in series with the circuit.
- The range selector switch connects an appropriate shunt resistor across the meter movement.
- Most of the current flows through the shunt, and a small current flows through the PMMC.
- The meter deflection indicates the current in the circuit.

c) Resistance Measurement

- The multimeter uses an internal battery as the power source.
- The unknown resistance is connected between the test terminals.
- Current flows through the resistance, and the meter deflection depends on the resistance value.
- A zero-adjust control is used to calibrate the meter before measurement.
- The multimeter operates by combining the functions of a voltmeter, ammeter and ohmmeter.
- Proper range selection ensures accurate and safe measurement of voltage, current and resistance.

Digital Multimeter (DMM)

Block Diagram



Input Terminals (High / Low)

- ❖ The unknown electrical quantity to be measured is applied at the input terminals.
- ❖ High terminal is the positive or active terminal.
- ❖ Low terminal is the reference or common terminal.
- ❖ These terminals accept AC voltage, DC voltage, current, or resistance inputs.

Function Selector Switch (AC / DC / Ohms)

- ❖ This switch selects the mode of measurement.
- ❖ Depending on the selection, the input signal is routed to:
 - AC measurement circuit
 - DC measurement circuit
 - Resistance (Ohms) measurement circuit
- ❖ It ensures correct signal conditioning for accurate measurement.

Shunt (Current Measuring Circuit)

- ❖ Used when the multimeter is set to current measurement.
- ❖ A low-value precision resistor connected in series with the input.
- ❖ Converts the input current into a proportional voltage.
- ❖ Protects internal circuits from high current.
- ❖ The voltage across the shunt is further processed like a DC signal.

DC Attenuator

- ❖ Used for DC voltage measurement.
- ❖ Consists of a resistor divider network.
- ❖ Reduces high DC input voltage to a safe and measurable level.
- ❖ Provides range selection (e.g., mV, V, tens of volts).
- ❖ Prevents damage to sensitive electronic components.

AC Attenuator

- ❖ Used for AC voltage measurement.
- ❖ Similar to the DC attenuator but designed for AC signals.
- ❖ Scales down high AC voltages before conversion.
- ❖ Maintains signal integrity over the required frequency range.

AC Converter (AC to DC Converter)

- ❖ Converts the attenuated AC signal into an equivalent DC signal.
- ❖ May use:
 - Rectifier circuits

- RMS-to-DC converters
- ❖ Required because the A/D converter can process only DC signals.
- ❖ Ensures accurate AC voltage representation on the display.

Ohms Converter (Resistance Measurement Circuit)

- ❖ Used when measuring resistance.
- ❖ A known internal voltage or current is applied to the unknown resistor.
- ❖ The resulting voltage drop is measured.
- ❖ Converts resistance into a proportional DC voltage.
- ❖ Based on Ohm's Law ($R = V / I$).

Analog Signal Selector / Multiplexer

- ❖ Selects one conditioned signal from:
 - DC attenuator output
 - AC converter output
 - Ohms converter output
- ❖ Sends the selected signal to the A/D converter.
- ❖ Ensures only one measurement path is active at a time.

A/D Converter (Analog-to-Digital Converter)

- ❖ Converts the analog DC signal into a digital number.
- ❖ Determines the resolution and accuracy of the multimeter.
- ❖ Common types used:
 - Dual-slope ADC
 - Successive approximation ADC
- ❖ Digital output is suitable for display and processing.

Precision Reference

- ❖ Provides a stable and accurate reference voltage.
- ❖ Essential for precise A/D conversion.
- ❖ Minimizes errors due to temperature and supply variations.
- ❖ Improves long-term stability of measurements.

Digital Display

- ❖ Displays the measured value in numerical form.
- ❖ Usually an LCD or LED display.
- ❖ Shows:
 - Measured quantity
 - Polarity
 - Decimal point
 - Units (V, A, Ω)

BCD Output (Binary Coded Decimal)

- ❖ Digital output in BCD format.
- ❖ Each decimal digit is represented separately.
- ❖ Used for external digital circuits, printers, or recorders.

Interface

- ❖ Enables communication with external devices.
- ❖ Used for data logging, storage, or remote monitoring.
- ❖ Common interfaces include:
 - USB
 - RS-232
 - GPIB

Power Supply

- ❖ Usually a battery-operated DC supply.

- ❖ Provides required operating voltages to all internal blocks.

Conclusion

The Digital Multimeter block diagram shows how different electrical quantities are:

1. Conditioned
2. Converted into DC form
3. Digitized using an A/D converter
4. Displayed or transmitted digitally

This systematic processing ensures high accuracy, safety, and versatility in electrical measurements.

Advantages of Digital Multimeter

- High accuracy and resolution
- Easy to read digital display
- High input impedance
- Compact and portable
- Less human reading error

Applications

- Measuring voltage, current, and resistance
- Testing electronic components
- Troubleshooting electrical and electronic circuits