UNIT:-07

1) Chopper Amplifier type Voltmeter :-

A chopper amplifier voltmeter is a type of electronic voltmeter used for measuring very low voltage signals often in the microvolt or multivolt range.

It utilizes a chopper amplifier to improve the measurement accuracy by reducing noise and drift.

* Working Principle :-

The primary working mechanism involves converting a DC input voltage into an AC signal using a chopper circuit essentially a switching circuit.

This AC signal is then amplied using an AC amplied which typically has better stability and noise characteristics than DC amplifiers.

After amplification, the AC signal is converted back to DC for measurements.

* Application :-

- Measurement of small DC voltage in Sensor ckt.
- Precision measurement system.
- Low frequency signal detection.

* Advantage :-

- High sensitivity and precision.
- Better noise immunity compared to traditional DC amplifier.

- Effective for low level measurement

* Disadvantages :-

- Complex circuitry
- Mechanical chopper may have limited lifespan and lower reliability.
- Signal processing delay due to chopping and filtering.

2.) AC Voltmeter - Full wave Rectifier :-

An AC voltmeter with full wave rectifier is a device used to measure the RMS (Root mean square) or average value of AC voltage

The employs a full-wave rectifier to convert the AC signal into a unidirectional DC signal for accurate voltage measurement.

* Working Principle :-

The full wave rectifier circuit in the AC voltmeter converts both the positive and negative half-cycle of the input AC voltage into positive half cycle.

* Circuit Components :

- Transformer optional :- steps down the input voltage is requrie.
- Full wave rectifier :- Typically made using :-
  → four diode in a bridge configuration bridge rectifier.

→ Two diodes with a centre tapped transformer

- Filter capacitor:- Smoothens the rectified signal
- DC voltmeter:- Measure the filtered DC voltage.

* Advantage:-
- Direct measurement of the peak value
- Useful for application involving transient signal
- Simple circuit design.

* Disadvantage:-
- Limited accuracy for non sinosoidal waveform
- Response time may be slow if capacitor discharge is not optimized.
- Errors can occur due to diode voltage drops and leakage currents.

True RMS Voltmeter:-

A true RMS (Root mean Square) voltmeter is a specialized voltmeter that measures the true RMS value of an AC or complex

* Working Principle:-

A true RMS voltmeter calculates the RMS value using the formula:-

$$V_{RMS} = \sqrt{\frac{1}{T}\int_0^T v(t)^2}$$

where,
T is the time period of the waveform
v(t) is the instantaneous voltage.

The key function is squaring the input averaging it overtime and then taking the

* Circuit Components :-

- Input Signal Conditioning :- Attenuates or amplifies the signal for processing.
- Squaring Circuit :- Square the instantaneous voltag usually done using precision.
- Averaging circuit :- computes the mean of the d squared signal.
- Display Unit :- Shows the RMS voltage value.

* Advantage :-

Accurate for all waveform types (sinousiodal square triangular distorted etc).

- Essential for Power and energy measurement in non-linear system.
- High accuracy in noisy environments.

* Disadvantage :-

- Potential errors from non-ideal components in analog design.
- Slower response time due to signal processing
- More complex and expensive.

Ohm-meter Servis and its type :-

- An ohm meters is a devices used to measure the electrical resistance of a component or circuit in ohms (Ω)

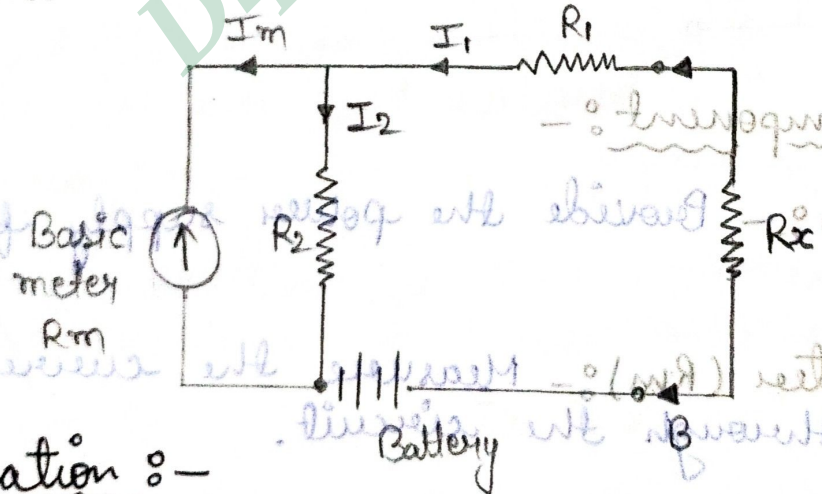
- A series ohmmeter is a device that measures the resistance to be measured is connected in series with the meters internal circuit.
- In a series ohmmeter battery provides a current that flows through the unknown resistance.

The current flowing through the circuit is measured by a galvanometer (current meter)

- The resistance value is inversely proportional to the current

* Circuit Components :-

- Battery :- Provides the necessary voltage.
- Galvanometer :- Measures the current.
- Resistor :- sets the measurement range and protect the circuit.
- Test leads :- Connect the ammeter to the resistor.



* Application :-

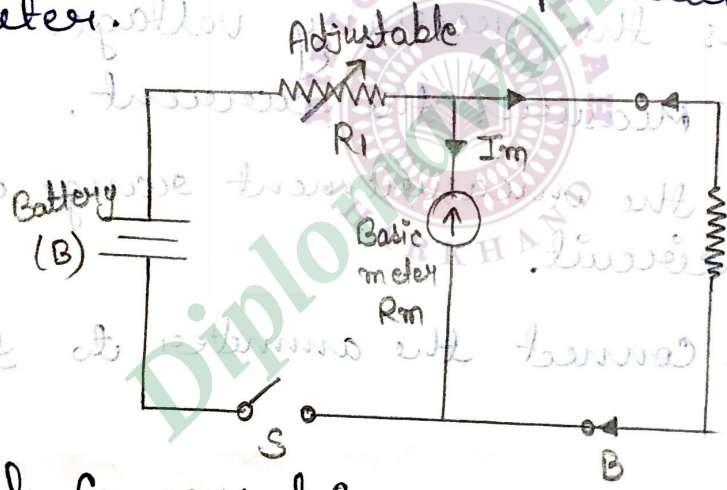
- Basic resistance measurement
- Suitable for testing circuit continuity.

* Advantages :-
- Simple circuit design.
- Low cost and easy to use.

* Disadvantage :-
- Limited measurement accuracy.
- Battery dependency for operation.
- cannot be used in live circuit.

Shunt type :-

A shunt type ohmmeter is used to measure low resistance value. In this configuration the unknown resistor is connected in parallel (shunt) with the meter.



* Circuit Component :-
- Battery (E) :- Provide the power supply for the circuit.
- Basic meter (Rm) :- Measure the current flowing through the circuit.
- Adjustable resistor (R_1) :- Used for callibration and controlling the current through the meter.

• Make Break switch (S) :- The resistance measured connected across terminal A and B.

* Working Principle :-

When the unknown resistance (R_1) is connected in parallel with the galvanometer the total current from the battery splits between the shunt path (R_c) and the meter (R_m).

The amount of current flowing through the meter depends on the value of the shunt resistance.

* Advantage :-

• Accurate measurement of small resistance.
• Better protection for the meter due to shunting.

* Disadvantage :-

• Require careful calibration.
• Complex circuiting compared to series ohmmeter.

* Application :-

Measuring small resistance such as in circuit breakers bonding resistance and cables resistance.

Used in Industrial testing where high precision for low resistance is essential.

Concept of Calibration of meters :-

Calibration is the process of adjusting and the accuracy of a measuring instrument comparing its reading with a known standard.

In ensure that the instrument provides accurate and consistent measurement within specified tolerence.

★ Why Calibration is Important :-

- Ensure measurement accuracy.
- Detects and corrects errors in the meter's performance.
- Maintain Consistency in measurement.
- Complies with quality and industry standard.

Steps in Calibration :-

- Selection of standard : Use a reference instrument standard with a higher accuracy level than then meter.
- Environmental Control :- Ensure stable environmental condition such as temperature and humidity such as they can impact readings.

Zero Adjustment :- Let the meter to zero applicable (for analog meters).

- Apply reference value :- Feed standard input signal (voltage, current, resistance or other quantities) to the meters.
- Record and compare reading :- Compare the meter's reading with standard value.

Adjust (If necessary) :-

- For analog meters use internal adjustment to ensure consistency for digital meter, use software calibration.

Verification :- Recheck reading after adjustment to ensure consistency across the measurement.

Document the result :- Record the calibration data and issue a calibration certification if required.

Example :- Callibration of an Analog ohmmeter.