VOLTMETERS - II

A.C voltmeters using rectifier:

The PMMC movement used in d.c. voltmeters can be effectively used in a.c. voltmeters. The rectifier is used to convert a.c. voltage to be measured, to d.c. This d.c., if required is amplified and then given to the PMMC movement. The PMMC movement gives the deflection proportional to the quantity to be measured.

The r.m.s. value of an alternating quantity is given by that steady current (d.c.) which when flowing through a given circuit for a given time produces the same amount of heat as produced by the alternating current which when flowing through the same circuit for the same time. The r.m.s value is calculated by measuring the quantity at equal intervals for one complete cycle. Then squaring each quantity, the average of squared v,llues is obtained. The square root of this average value is the r.m.s. value. The r.m.s means root-mean square i.e. squaring, finding the mean i.e. average and finally root.

If the waveform is continuous then instead of squaring and calculating mean, the integratioll is used. Mathematically the r.m.s. value of the continuous a.c. voltage having time period T is given by,

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T V_{in}^2 \, dt}$$

The $\frac{1}{T}$ term indicates the mean value or average value.

For **purely sinusoidal quantity,**

$$V_{rms} = 0.707 \, V_m$$

where V_m = peak value of the sinusoidal quantity

If the a.c. quantity is continuous then average value can be expressed mathematically using an integration as,

$$V_{av} = \frac{2}{T}\int_{0}^{T/2} V_{in}\, dt$$

The interval T/2 indicates the average over half a cycle.

For **purely sinusoidal quantity,**

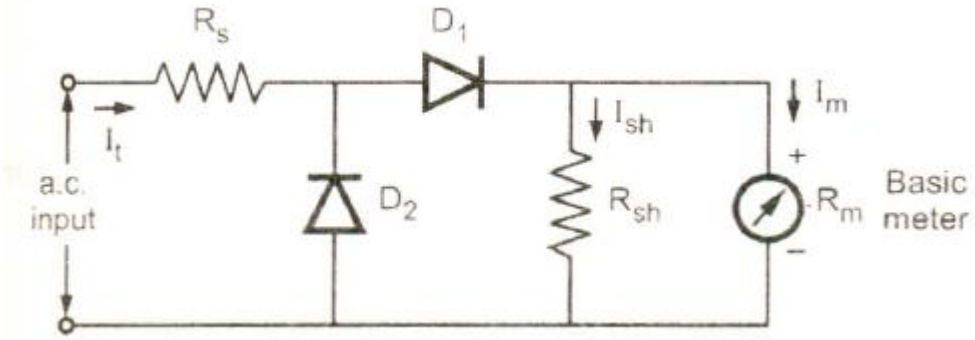
$$V_{av} = \frac{2}{\pi} V_m = 0.636\ V_m$$

where V_m = Peak value of the sinusoidal quantity.

The form factor is the ratio of r.m.s. value to the average value of an alternating quantity.

$$K_f = \frac{\text{r.m.s. value}}{\text{average value}} = \text{form factor}$$

Basic rectifier type voltmeter:

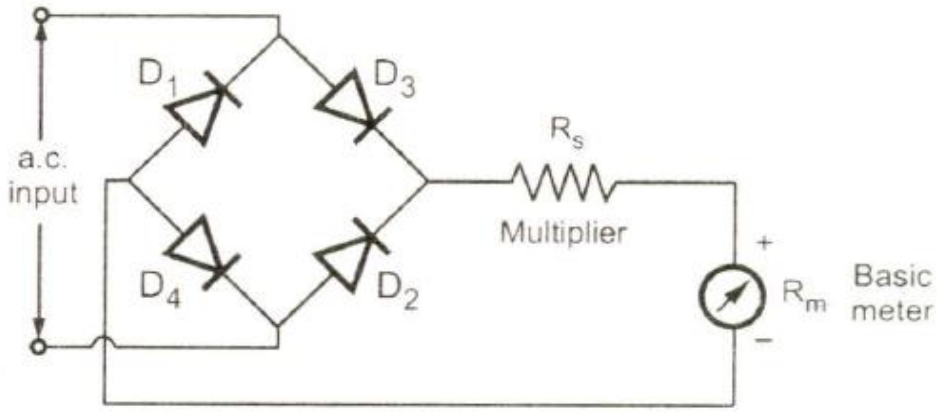


The diodes D1 and D2 are used for the rectifier circuit. The diodes show the nonlinear behaviour for the low currents hence to increase the current through diode D1, the meter is shunted with a resistance Rsh' This ensures high current through diode and its linear behaviour.

When the a.c. input is applied, for the positive half cycle, the diode 01 conducts and causes the meter deflection proportional to the average value of that half cycle. In the negative cycle, the diode O2 conducts and 01 is reverse biased. The current through the meter is in opposite direction and hence meter movement is bypassed. Thus due to diodes, the rectifying action produces pulsating d.c. and lile meter indicates the average value of the input.

A.C voltmeter using fullwave rectifier:

The a.c. voltmeter using full wave rectifier is achieved by using bridge rectifier consisting of four diodes, as shown in the Fig



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