Q-2 (H), Paper IV

Dr. Supriya Kumari
Deptt. of Physics
J.N.C. Madhubani.

A.C Circuits :- Alternating current.

Mean value of alternating current: It is that steady current which sends the same charge through a circuit in the same time as the alternating current does in half its time period.

Root mean square value of an alternating current.

It is that steady dc current which produces the same heating effect in a resistance in a given time as the alternating current does in the same resistance in the same time.

The strength of a.c is not constant; To find the heating effect we take a large number of instantaneous values for a half cycle of a.c, square them, find their mean and take their square root. Hence the name root mean square value. It is also known as virtual value or the effective value of an a.c.

Expression for Mean value: The a.c is represented by

$$i = i_0 \sin \omega t$$

Let us suppose the value of the current remains constant for a very small time dt, then

charge passing in time dt = $i \cdot dt$

Hence charge passing in time

$$T = \int_0^T i\,dt = \int_0^T i_0 \sin \omega t \cdot dt$$

where T is half the time period of the a.c.

If I denotes the mean value of the current the charge passing in time T = $I \cdot T$

$$\text{or } I\,T = \int_0^T i_0 \sin \omega t = \frac{i_0}{\omega} \left[-\cos \omega t \right]_0^T$$

$$\text{or } I = \frac{i_0}{\omega T} \left[1 - (-1) \right] \qquad (\text{since } \omega T = \pi)$$

$$= \frac{2 i_0}{\pi}$$

Therefore the average or mean value of an a.c is $\frac{2}{\pi}$ or 0.637 times the max^m value of current.

The mean value for a complete cycle is zero as the current changes direction half the period.