QB365 Question Bank Software

12th Physics Case study Questions Alternating Current For - 2024

12th Standard

Physics

SECTION - A 2 x 4 = 8

1) A transformer is essentially an a.c. device. It cannot work on d.c. It changes alternating voltages or currents. It does not affect the frequency of a.c. It is based on the phenomenon of mutual induction. A transformer essentially consists of two coils of insulated copper wire having different number of turns and wound on the same soft iron core.
The number of turns in the primary and secondary coils of an ideal transformer are 2000 and 50 respectively. The primary coil is connected to a main supply of 120 V and secondary coil is connected to a bulb of resistance 0.6Ω
(i) The value of voltage across the secondary coil is
(a) 5V (b) 2V (c) 3 V (d) 10 V
(ii) The value of current in the bulb is
(a) 7 A (b) 15 A (c) 3 A (d) 5 A
(iii) The value of current in primary coil is
(a) 0.125 A (b) 2.52 A (c) 1.51 A (d) 3.52 A
(iv) Power in primary coil is
(a) 20W (b) 5W (c) 10 W (d) 15W
(v) Power in secondary coil is
(a) 15W (b) 20 W (c) 7W (d) 8 W

Answer : **(i) (c)** : As $\frac{E_s}{E_p} = \frac{n_s}{n_p} \Rightarrow E_s = E_p \cdot \frac{n_s}{n_p}$
$= \frac{120 \times 50}{2000} = 3 \text{ V}$
(ii) (d) : $I_s = \frac{E_s}{R} \Rightarrow I_s = \frac{3}{0.6} = 5 \text{ A}$
(iii) (a) : As $\frac{I_p}{I_s} = \frac{E_s}{E_p}$
$\Rightarrow I_p = \frac{E_s}{E_p} \times I_s = \frac{3}{120} \times 5 = 0.125 \text{ A}$
(iv) (d) : Power in primary $P_p = E_p \times I_p = 120 \times 0.125$
= I5W
(v) (a) : Power in secondary coil $P_s = E_s \times I_s = 3 \times 5$
= 15W

2) The average power over one full cycle of AC is given by P = V cos ϕ . It is also known as true power. The term cos ϕ is known as power factor, where ϕ is the phase difference between I and E.
Answer the following Questions based on above passage.
(i) What is the power factor of an AC circuit containing resistor and inductor?
(ii) What is the average power of an AC circuit containing purely inductance?
(iii) A resistor of 2Ω is connected to an AC supply 220 V - 150 Hz. What is the average power associated with the resistor?
(iv) A component X is connected to an AC supply E = E_0 sin ωt such that maximum power factor is obtained. Identify the component X.

Answer : (i) The power factor is give by

$\cos\phi = \frac{R}{Z}$

For a circuit containing resistor and inductor

$Z = \sqrt{R^2 + (\omega L)^2}$

$\therefore \quad \cos\phi = \frac{R}{\sqrt{R^2+(\omega L)^2}}$

(ii) For purely inductive circuit, $\phi = \frac{\pi}{2}$

$\therefore P_{\text{av}} = E_{\text{rms}} I_{\text{rms}} \cos\phi = E_{\text{rms}} I_{\text{rms}} \cos\frac{\pi}{2} = 0$

(iii) R = 2 Ω, E_{rms} = 220 V, f = 150 Hz

$\therefore$ For a circuit containing only restor

$\phi = 0^\circ \Rightarrow \cos\phi = 0$

$\therefore P_{\text{av}} = \frac{E_{\text{rms}}^2}{R} = \frac{(220)^2}{2} = 24200 \text{ W}$

(iv) For maximum power factor, $\cos\phi = 1$