NUMERICAL PROBLEMS

15.1 A transformer is needed to convert a mains 240 V supply into a 12V supply. If there are 2000 turns on the primary coil, then find the number of turns on the secondary coil.

Solution:

Given Data:

$V_p = 240\text{ V}$

$V_s = 12\text{V}$

$N_p = 2000$

Required: $N_s = ?$

Formula:

$$\frac{N_s}{N_p} = \frac{V_s}{V_p}$$

$$\mathbf{Ns = \frac{Vs \times Np}{Vp} = \frac{12 \times 2000}{240} = 100}$$

15.2 A step-up transformer has a turn ratios of 1:100.An alternating supply of 20V is connected across the primary coil. What is secondary voltage?

Solution:

Given Data:

$N_p : N_s = 1:100$

$V_p = 20V$

Required :

$\mathbf{V_s = ?}$

Formula

$$\frac{N_p}{N_s} = \frac{1}{100}$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$Vs = \frac{N_s \times V_p}{N_p} = \frac{100}{1} \times 20$$

$V_s = 2000$ Volt Ans

15.3 **A step – down transformer has a turns ratio of 1:100. An ac voltage of amplitude 170V is applied to the primary. If the current in the primary is 10 mA, what is the current in the secondary?**

Solution:

Given Data:

$$N_s : N_p = 1:100$$

$$\frac{N_s}{N_p} = \frac{1}{100}$$

$$V_p = 170v$$

$$I_p = 1mA = 1 \times 10^{-3}\ A$$

Required

$$I_s = ?$$

Formula

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$V_s = \frac{N_s}{N_p} \times V_p$$

$$= \frac{1}{100} \times 170 = 1.7V$$

For an ideal transformer

Power of primary =Power of secondary

$$P_p = P_s$$

$$I_p V_p = I_s V_s$$

$$\frac{I_p V_p}{V_s} = I_s$$

$$\frac{1 \times 10^{-3} \times 170}{1.7} = I_s$$

$$0.1\ A = I_s \Rightarrow I_s = 0.1A\ \text{Ans}$$

15.4 **A transformer, designed to convert the voltage from 240 V a.c. mains to 12V, has 4000 turns on the primary coil. How may turns should be on the secondary coil? If the transformer were 100% efficient, what current would flow through the primary coil when the current in the secondary coil was 0.4A?**

Solution:

Given Data:

$$V_p = 240V$$

$$V_s = 12V$$

$$N_p = 4000$$

Required: $N_s = ?$

Formula:

$$\frac{N_s}{N_p} = \frac{V_s}{V_p}$$

$$Ns = \frac{V_s \times N_p}{v_p} = \frac{12 \times 4000}{240}$$

$N_s = 200$ Ans

$I_p = ?$

$I_s = 0.4A$

$P_p = P_s$

$I_pV_p = I_sV_s$

$$Ip = \frac{I_sV_s}{V_p} = \frac{0.4 \times 12}{240}$$

$I_p = 0.02$ A

15.5 **A power station generates 500 MW of electrical power which is fed to a transmission line. What current would flow in the transmission line if the input voltage is 250 kV?**

Solution:

Given Data:

$V = 250 \times 10^3 V$

Power = $P = 500 \times 10^6 W$

Required: $I = ?$

Formula: $P = IV$

$$\frac{P}{V} = I$$

$$\frac{500 \times 10^6}{250 \times 10^3} = I$$

$2 \times 10^3 A = I \quad \Rightarrow I = 2KA$ **Ans**

15.6 **The diagram shows a wind turbine which a 150 kW generator with an output voltage of 1000V. The voltage is increased by transformer T_1 to 10 000 V for transmission to a town 5 km away through power lines with a total resistance of 2Ω. Another transformer, T, at the town reduces the voltage to 250V. Assume that the transformers are 'Ideal' when the system is running at full power: (Figure from the textbook page 143)**

Solution:

Given Data:

Power = P = 150 k W

$P = 150 \times 10^3 W$

At T_1 $Vp = 10000$ V

$R = 2\Omega$

At T_2 $Vs = 250$