PHYSICS - X-PART-8 CLASS 22

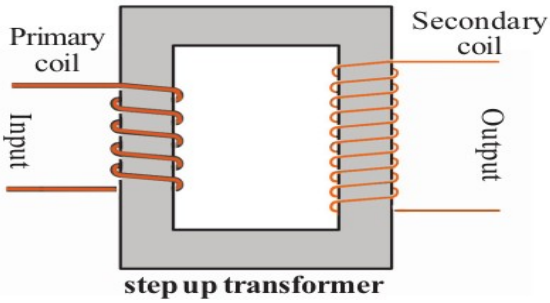
Transformer

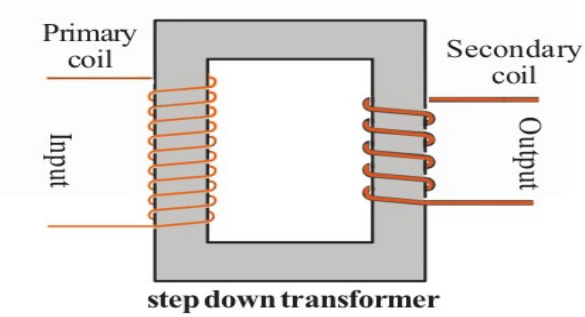
Working Principle : Mutual induction

➔ *Transformer is a device for increasing or decreasing the voltage of an AC without any change in the electric power.*

➔ *Transformers are of two types*
- *Step up transformer*
- *Step down transformer*

Difference between Step up transformer and Step down transformer





Step up transformer	Step down transformer
Thick wires are used in the Primary.	Thick wires are used in the Secondary.
Less number of turns are used in the Primary	Less number of turns are used in the Secondary
Thin wires are used in the Secondary.	Thin wires are used in the Primary.

➔ ***The emf in each turn of the primary and the secondary coils will be the same.***

➔ ***Let the emf in one turn be ε***

Then, the emf in the primary is $V_p = N_p \times \varepsilon$

The induced emf in the secondary is $V_s = N_s \times \varepsilon$

The relation between the voltage and the number of turns of a transformer

➔ ***The voltage is directly proportional to the number of turns***
(The voltage increases as the number of turns increases and the voltage decreases as the number of turns decreases)

The primary voltage - V_p
The number of turns in the primary - N_p
The secondary voltage - V_s
The number of turns in the secondary - N_s

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

The relation between the voltage and the current of a transformer

➔ ***The voltage is indirectly proportional to the current (The voltage increases as the current decreases and the voltage decreases as the current increases)***

➔ ***If there is no loss of power from a transformer***

➔ ***The power in the primary and the secondary coils of a transformer is the same.***

Power = Voltage x Current

Primary power, Vp x Ip = secondary power, Vs x Is

That is

$$V_P \times I_P = V_S \times I_S$$

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

In a step up transformer the voltage in the secondary coil is more and the current is less. But in a step down transformer the secondary voltage is less and the current is more.

➔ ***A transformer working on a 240 V AC supplies a voltage of 8 V to an electric bell in the circuit. The number of turns in the primary coil is 4800. Calculate the number of turns in the secondary coil.***

The primary voltage $V_p = 240\ V$

The number of turns in the primary $N_p = 4800\ turns$

The secondary voltage $V_s = 8\ V$

The number of turns in the secondary $N_s = ?$

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

Ns = (Vs x Np) / Vp

= (8 x 4800) / 240

= 38400/240

Ns = 160 turns

➔ ***The input voltage of a transformer is 240 V AC. There are 80 turns in the secondary coil and 800 turns in the primary. What is the output voltage of the transformer?***

The primary voltage	$V_p = 240\ V$
The number of turns in the primary	$N_p = 800\ turns$
The secondary voltage	$V_s = ?$
The number of turns in the secondary	$N_s = 80\ turns$

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

$$Vs = (Ns \times Vp) / Np$$

$$= (80 \times 240) / 800$$

$$= 19200/800$$

$$Vs = 24\ V$$

Worksheet