ALTERNATING CURRENT

TRANSFORME

TRANSFORMER:

A transformer is an electrical apparatus designed for the conversion of alternating current, either from low voltage to high voltage or vice versa. When it amplifies the input voltage, it is referred to as a "step-up" transformer, and when it reduces the input voltage, it is termed a "step-down" transformer.



PRINCIPLE:

The functioning of a transformer relies on the concept of mutual induction. In this context, when there is a fluctuating current passing through one of the two coils that are inductively connected, it generates an induced electromotive force (emf) in the other coil.

CONSTRUCTION:

A transformer is primarily composed of two coils constructed from insulated copper wire, and these coils possess varying numbers of turns. They are wound around a common core made of soft iron. The coil that receives the electrical energy input is known as the "primary" coil, while the coil from which energy is extracted or where the output is obtained is referred to as the "secondary" coil.

To mitigate energy losses associated with eddy currents, laminated sheets are employed. The high permeability of soft iron ensures that nearly the entire magnetic flux generated by the current in the primary coil predominantly remains within the iron core and thus fully traverses through the secondary coil. Two common configurations are typically used for the arrangement of the primary and secondary coils in a transformer.

CORE TYPE:

In this configuration, the primary and secondary coils are wound on distinct limbs or sections of the core.

SHELL TYPE:

CLASS12

In this setup, the primary and secondary coils are wound atop one another on a single limb or section of the iron core.

THEORY:

Let's examine the scenario in which there is no load connected to the secondary; in other words, the terminals of the secondary are left unconnected or open. For this situation, we denote N1 as the number of turns in the primary coil and N2 as the number of turns in the secondary coil.

So, the generated electrical voltage in the primary coil

$$v_{\rm p} = -N_1 \frac{\mathrm{d}\phi}{\mathrm{d}t}$$

The created electrical voltage in the secondary coil

$$v_{\rm s} = -N_2 \frac{\mathrm{d}\phi}{\mathrm{d}t}$$

Here, " ϕ " represents the amount of magnetic flux associated with each turn of either the primary or secondary coil at a specific moment. Thus

$$\frac{v_s}{v_p} = \frac{N_2}{N_1}$$

The proportion $\frac{N_2}{N_1}$, which signifies the number of turns in the secondary coil compared to the number in the primary coil, is known as the transformer's turn's ratio. This ratio is also commonly referred to as the transformation ratio.

For step up transformer: N2 > N1 For step down transformer: N1 > N2

CURRENTS IN PRIMARY AND SECONDARY:

If we assume the transformer to be ideal, meaning that there are no energy losses, then the input power is equal to the output power

 $V_p I_p = V_s I_s$

Where I p and I S are the currents in the primary and secondary respectively.

$$\frac{I_p}{I_s} = \frac{V_s}{V_p} = \frac{N_2}{N_1}$$

CLASS12

PHYSICS

EFFICIENCY:

The efficiency of a transformer is defined as

 $\eta = \frac{Power \ output}{Power \ input} \times 100\%$

In actual transformers, their efficiency is relatively high, typically ranging from 90% to 98%, but it's not 100%.