



# SNS COLLEGE OF ALLIED HEALTH SCIENCES- COIMBATORE 35



DEPARTMENT : RADIOGRAPHY AND IMAGNG TECHNOLOGY

SUBJECT : GENERAL PHYSICS, RADIATION PHYSICS AND PHYSICS OF  
DIAGNOSTIC RADIOLOGY

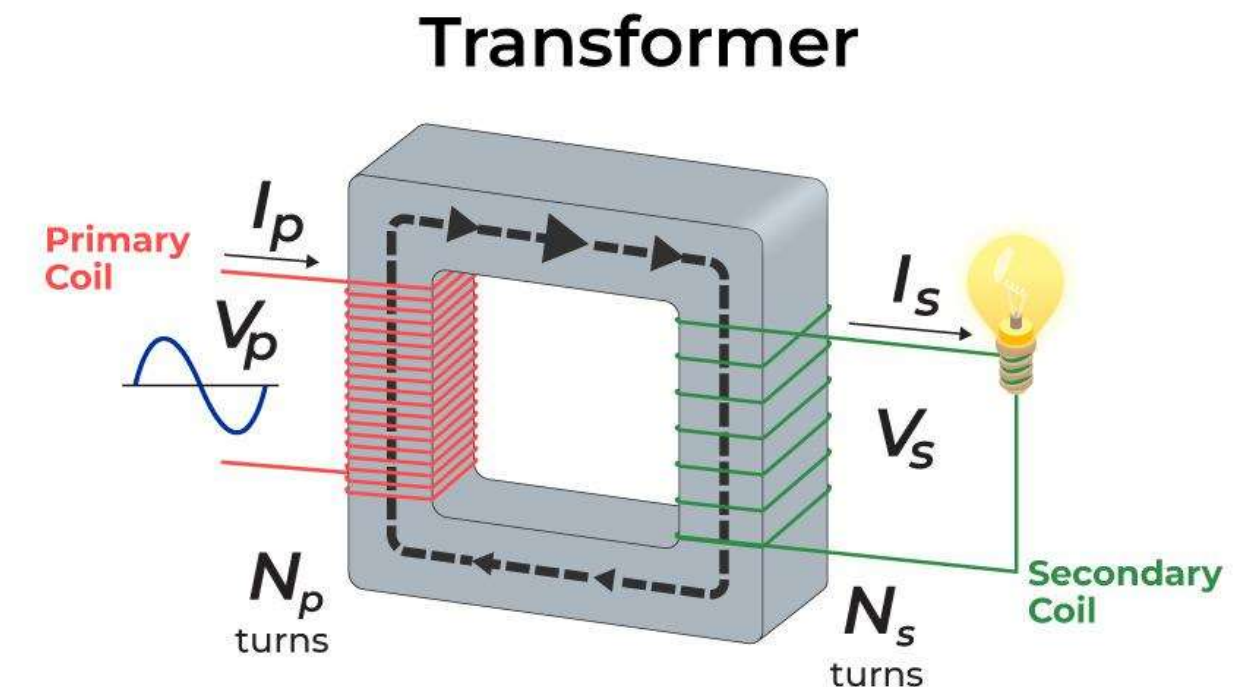
PAPER : PAPER II ( UNIT 5 – PHYSICS OF DIAGNOSTIC RADIOLOGY : X-ray TUBE )

TOPIC : 11. TRANSFORMERS

# TRANSFORMERS

## TRANSFORMER

- Transformer is a static electrical machine that transfers AC electrical power from one circuit to the other circuit without physical contact and without changing its frequency and phase, but the voltage can be increased or decreased.
- The transformer consists of two circuits, namely the primary circuit and the secondary circuit.
- Both circuit coils are wound around an iron core. When current flows through the primary circuit, a magnetic field is generated, which induces a current to flow in the secondary circuit.



# LAW OF TRANSFORMER

## 1. Transformer Law of Voltage

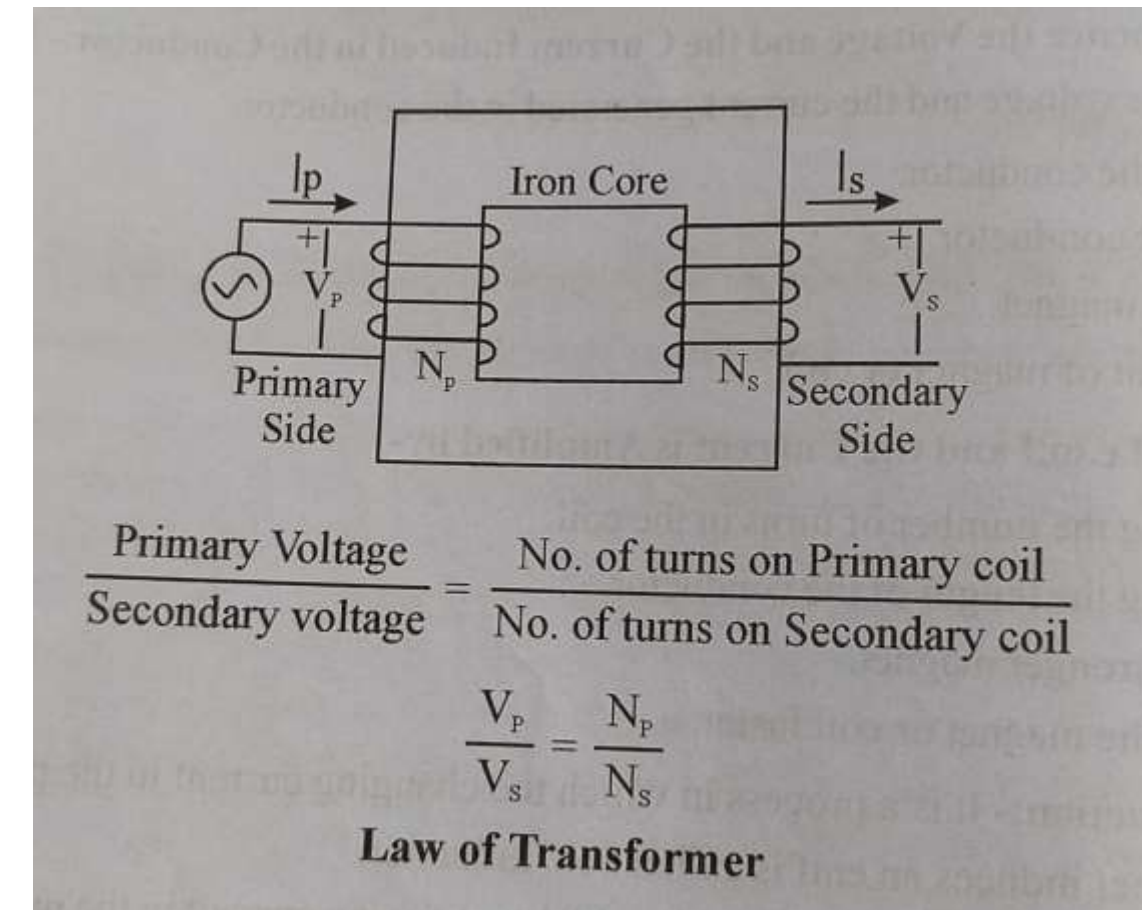
- The ratio of the incoming voltage and outgoing voltage is proportional to the number of turns on both the primary and the secondary coils.
- $V_p / V_s = N_p / N_s$
- V-voltage, N=number of turns, p= primary coil, s-secondary coil.

## 2. Transformer Law of Current

- The change in current is inversely proportional to the ratio of the number of turns in the primary coil to the number of turns in the secondary coil.
- $I_s / I_p = N_1 / N_2 = \text{current}$ , N=number of turns,, p= primary coil, s-secondary coil.

## 3. Turn Ratio

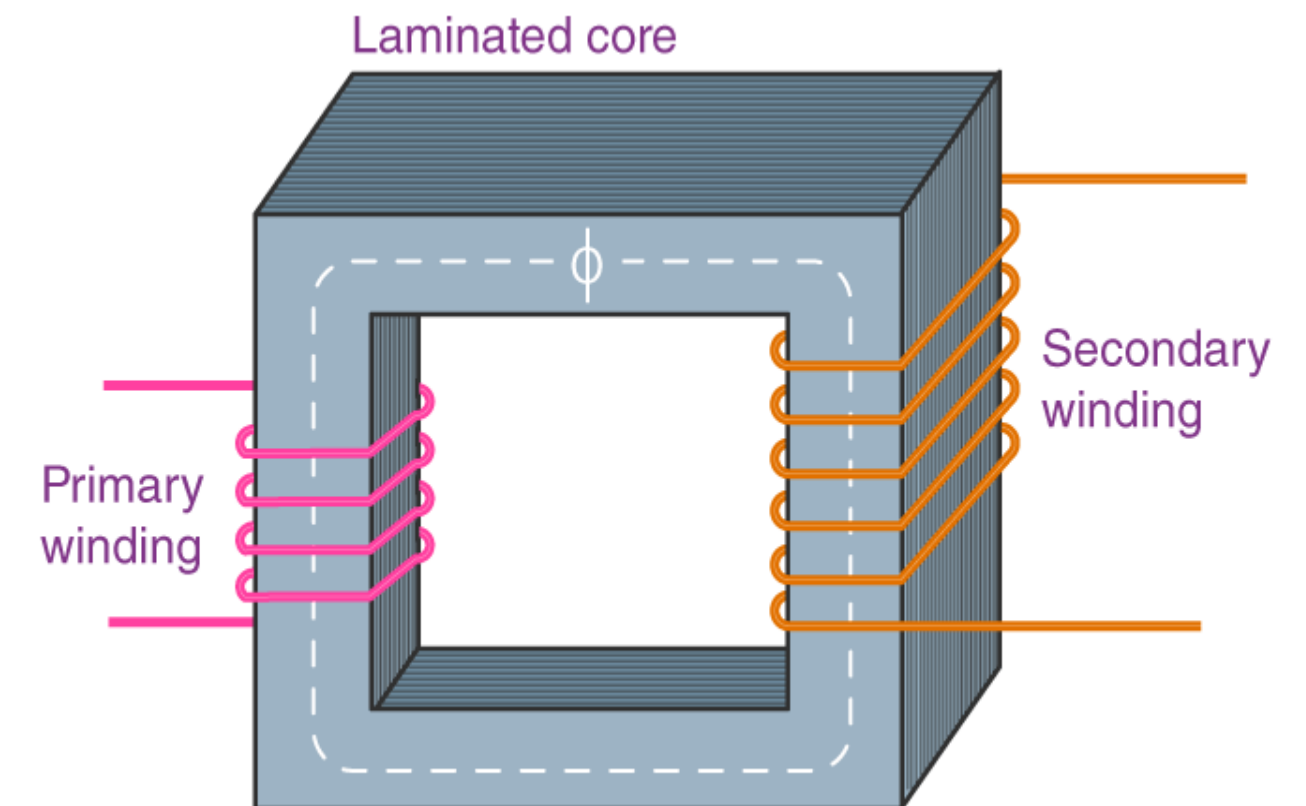
- The ratio of the number of turns in the secondary coil and the number of turns in the primary coil.
- $N_s : N_p$  - If the number of turns in the secondary coil is greater than the primary circuit, the voltage is increased.



# TYPES OF TRANSFORMERS

## 1. Step-Down Transformer

- A transformer in which the secondary voltage is lower than the primary voltage is called a step-down transformer.
- In the step-down transformer, the numbers of turns in the secondary coil are lesser than in the Primary coil.
- The filament circuit consists of a step-down transformer to reduce the voltage from 220V to 10V.
- It controls the heating of filament.
- If the voltage of the filament is too high, the filament may burn, thus reducing the voltage, and the current flows through a step-down transformer before reaching the filament.



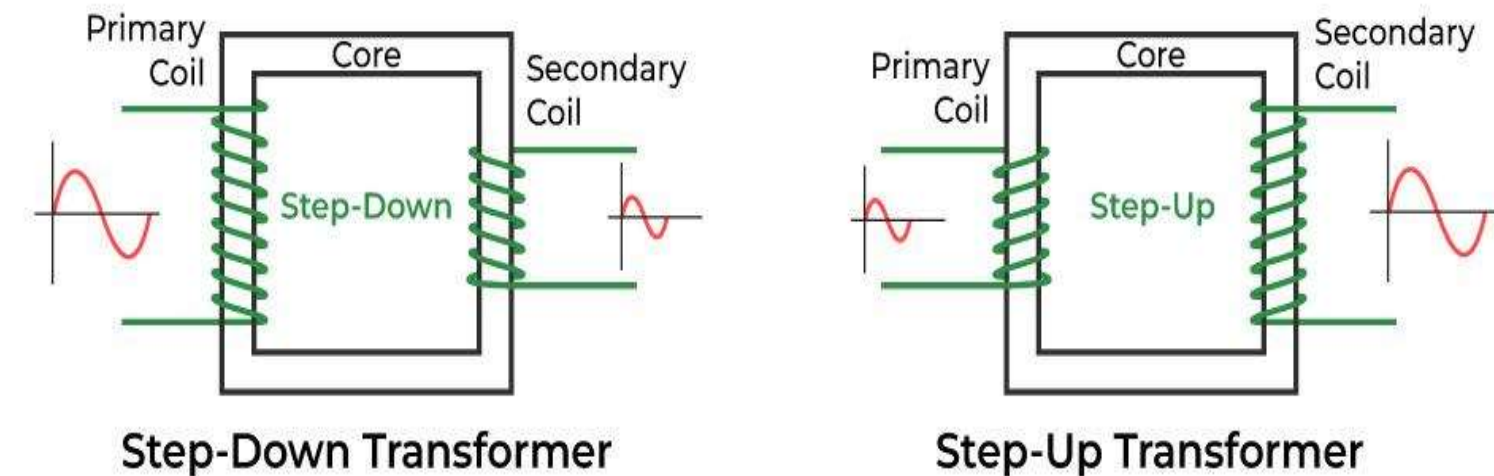
# TYPES OF TRANSFORMERS

(Autotransformer and step-up transformer - Anode High voltage circuit consists of autotransformer and step-up transformer)

## 2. AUTOTRANSFORMER

- The autotransformer has only one winding.
- The winding acts as both the primary and secondary coils of the transformer.
- The autotransformer regulates the voltage which is supplied to the step-up transformer.
- The autotransformer has a KVp selection switch, from which the required tube voltage can be selected.

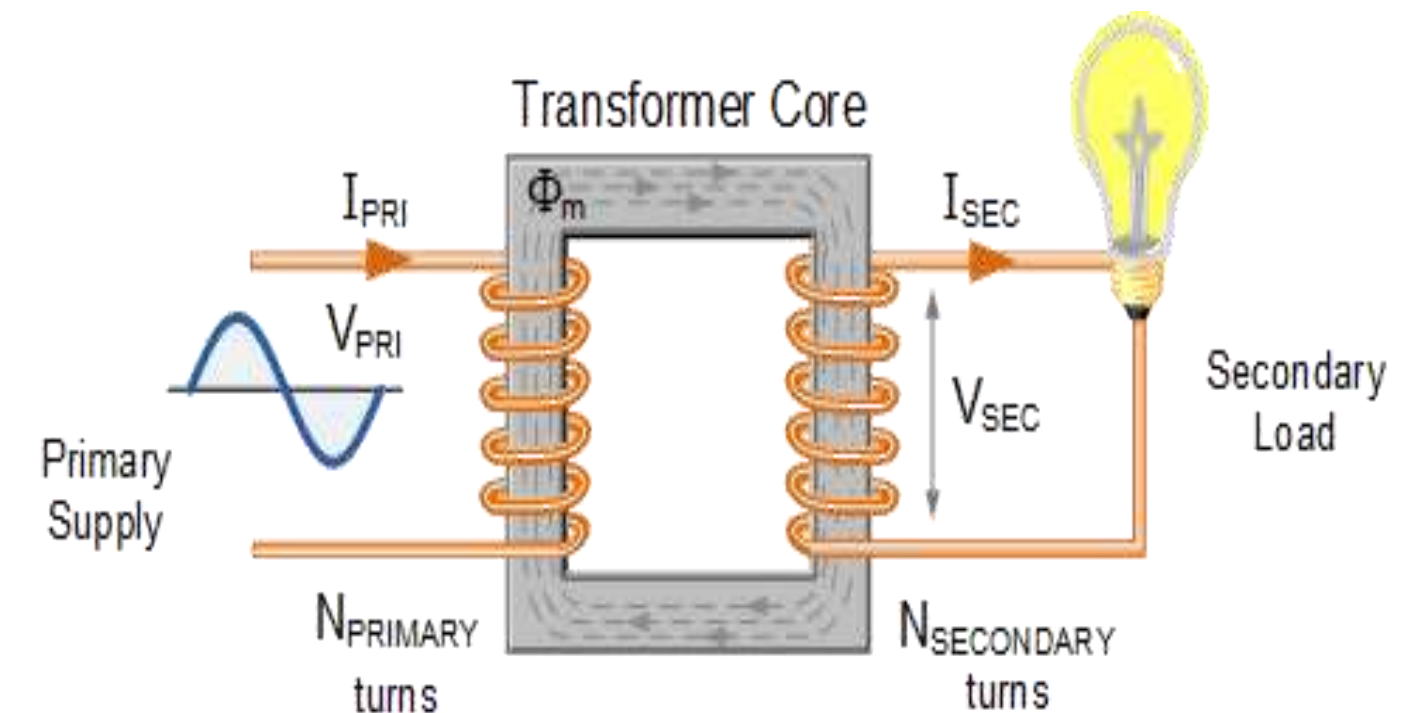
## Types of Transformer



# TYPES OF TRANSFORMERS

## 3. STEP-UP TRANSFORMER

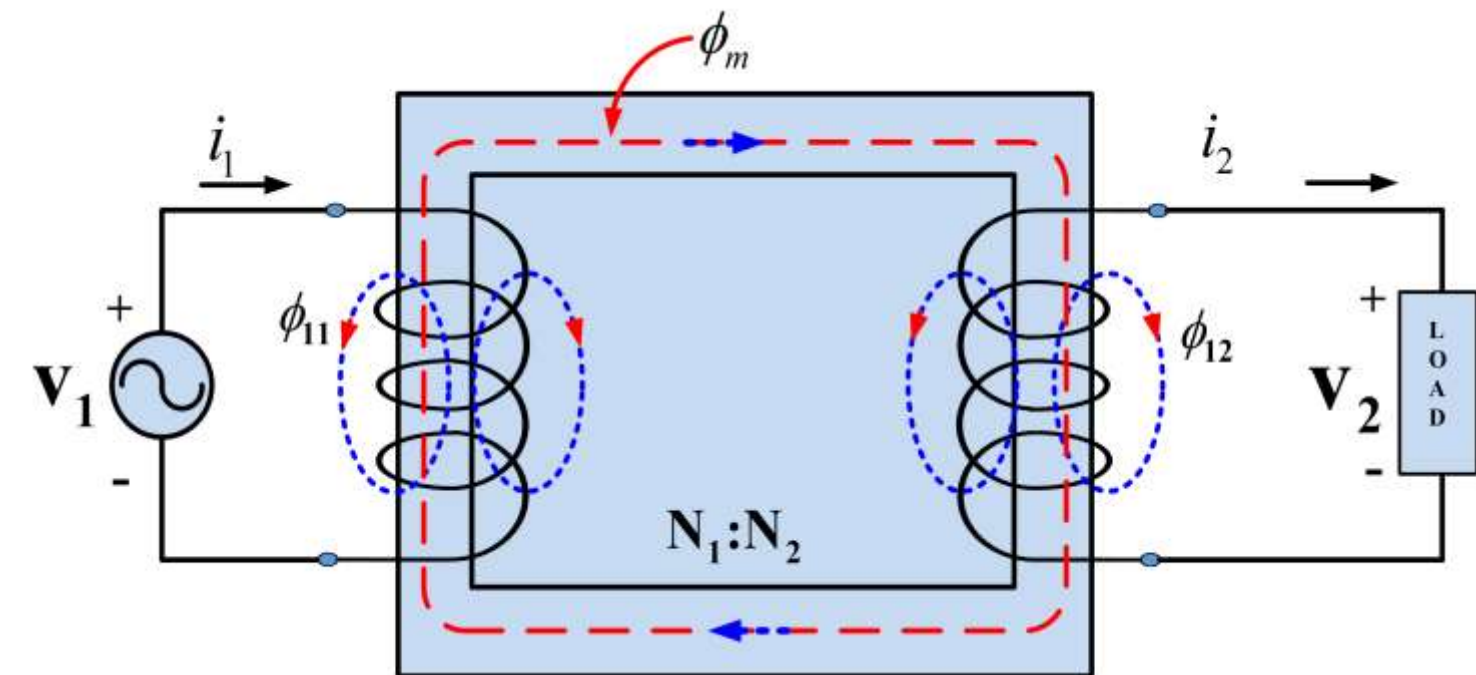
- A transformer in which the secondary voltage is greater than the primary voltage is called a step-up transformer.
- In this type of transformer, the number of turns in the secondary coil is greater than the Primary coil.
- The voltage coming from the autotransformer passes through the step-up transformer, where it is significantly increased



# EFFICIENCY

## EFFICIENCY OF A TRANSFORMER

- It can be defined as the output power divided by the input power.
- Efficiency = Power out / power in x 100%





# TRANSFORMER LOSSES



## TRANSFORMER LOSSES

- The loss can be defined as the difference between input power and output power.
- The transformers are not 100% efficient, some of their energy is lost in the form of heat, and these are

### 1. EDDY CURRENT LOSS IN TRANSFORMER

- When the AC current is supplied to the primary winding, which produces magnetizing flux, this flux induces an e.m.f within the iron core.
- This causes a small circulating current within the core. This current is called an eddy current which produces a lot of heat. This problem can be rectified by, laminated core.





# TRANSFORMER LOSSES



## 2. COPPER LOSS

- Copper loss occurs due to the transformer winding resistance.

## 3. HYSTERESIS LOSSES

- The hysteresis losses occur due to the variation of the magnetization in the core of the transformer.
- Hysteresis Losses are caused due to the repeated magnetization and demagnetization in the transformer core.
- This loss depends upon the volume and grade of iron.
- For reducing this loss, soft material is used for the core.

## 4. DIELECTRIC LOSS

- Dielectric loss occurs in the oil of the transformer whenever insulation of the transformer gets damage or degrades thus the efficiency of the transformer decrease.



# INTERROGATIONS



1. Define Exposure switches
2. What is ABC ?
3. What is the principle of AEC ?



# REFERENCES

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3. Basic Medical Radiation physics – Stanton.
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**THANK YOU**