

# **SNS COLLEGE OF ENGINEERING**

**Coimbatore-35**

**An Autonomous Institution**

Accredited by NBA – AICTE and Accredited by NAAC – UGC  
with 'A+' Grade

Approved by AICTE, New Delhi & Affiliated to Anna  
University, Chennai

## **DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

### **ELECTRICAL ENGINEERING & INSTRUMENTATION**

II YEAR/ III SEMESTER

#### **UNIT 2 – TRANSFORMER**

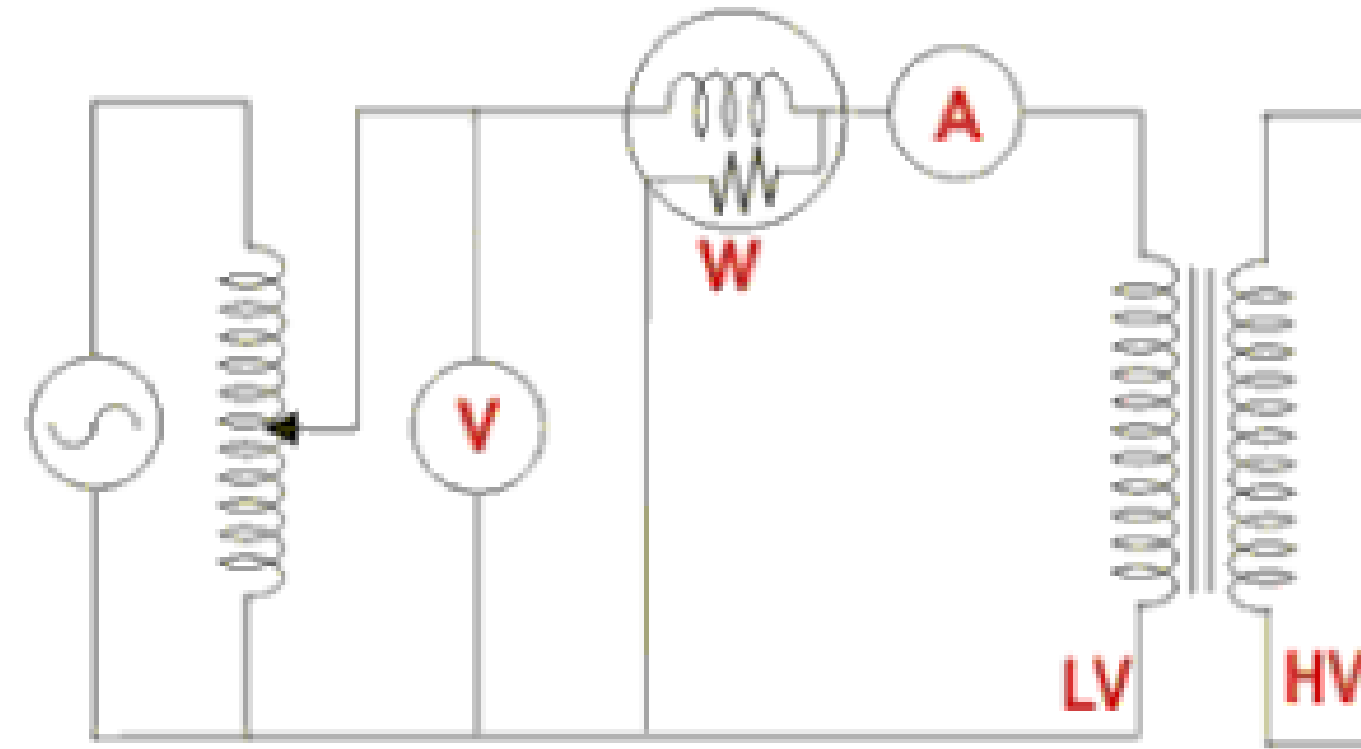
#### **TOPIC 5 – OPEN AND SHORT CIRCUIT TEST OF TRANSFORMER**

# OPEN AND SHORT CIRCUIT TEST OF TRANSFORMER

Open and short circuit tests are performed on a transformer to Pre determine the:

- Equivalent circuit of transformer
- Voltage regulation of transformer
- Efficiency of transformer

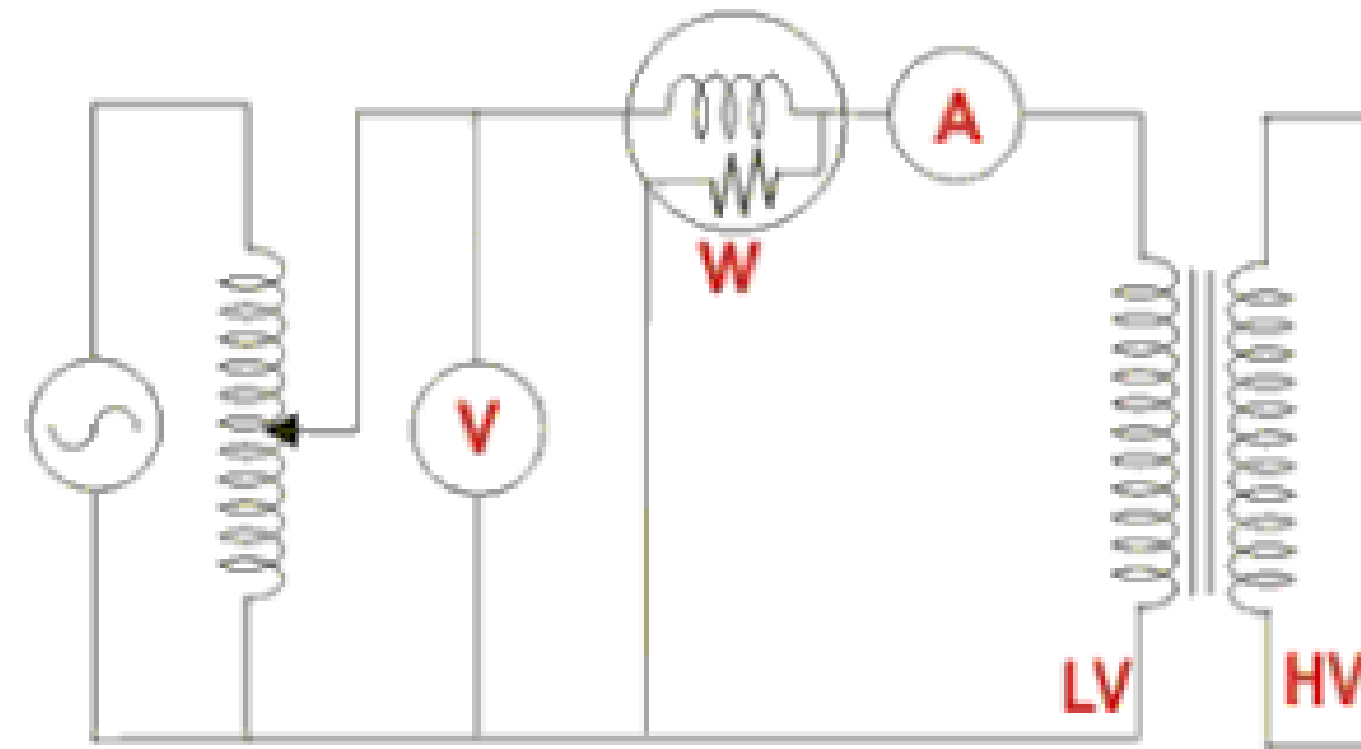
# OPEN CIRCUIT TEST ON TRANSFORMER



Open Circuit Test on Transformer

A voltmeter, wattmeter, and an ammeter are connected in LV side of the transformer as shown. The voltage at rated frequency is applied to that LV side with the help of a variac of variable ratio auto transformer.

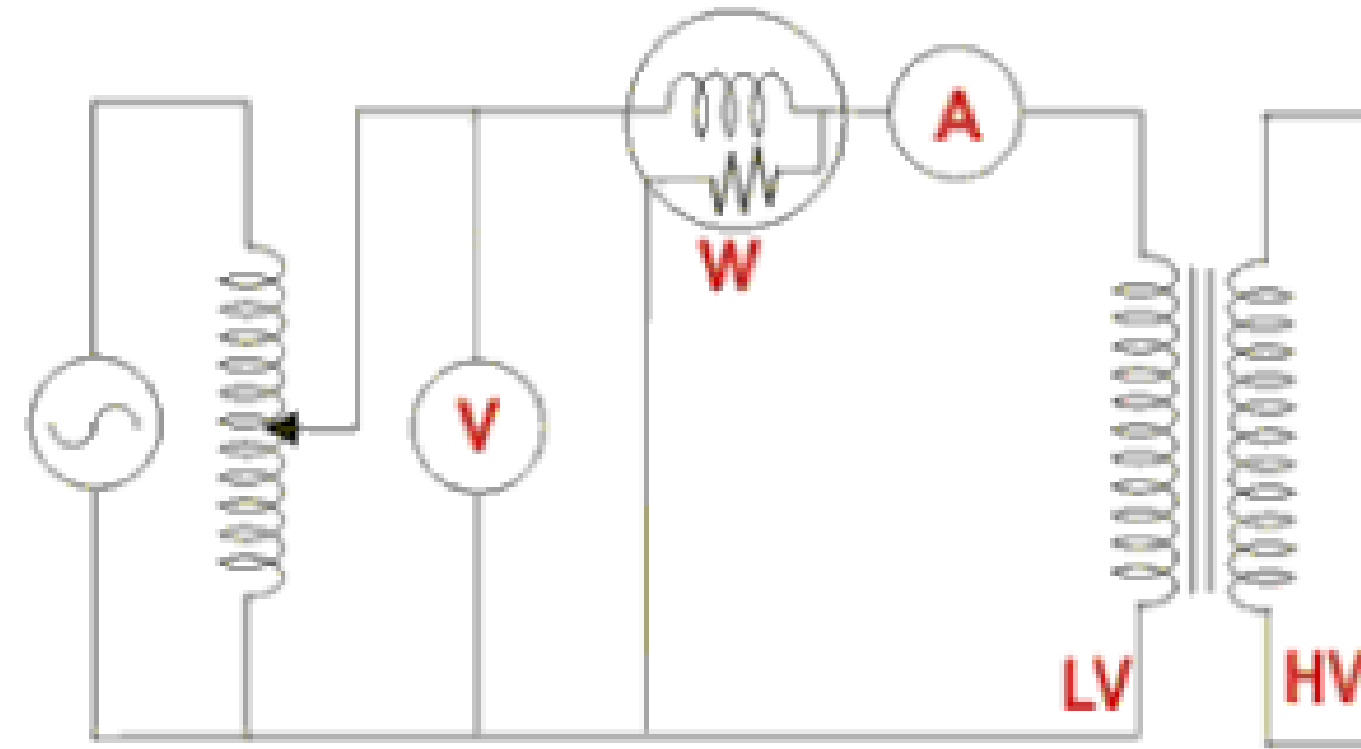
# OPEN CIRCUIT TEST ON TRANSFORMER



Open Circuit Test on Transformer

The HV side of the transformer is kept open. Now with the help of variac, applied voltage gets slowly increased until the voltmeter gives reading equal to the rated voltage of the LV side. After reaching rated LV side voltage, we record all the three instruments reading (Voltmeter, Ammeter and Wattmeter readings).

# OPEN CIRCUIT TEST ON TRANSFORMER



Open Circuit Test on Transformer

The ammeter reading gives the no load current  $I_e$ . As no load current  $I_e$  is quite small compared to rated current of the transformer, the voltage drops due to this current that can be taken as negligible.

## OPEN CIRCUIT TEST ON TRANSFORMER

Let us consider wattmeter reading is  $P_o$ .

$$P_o = \frac{V_1^2}{R_m}$$

Where,  $R_m$  is shunt branch resistance of transformer.

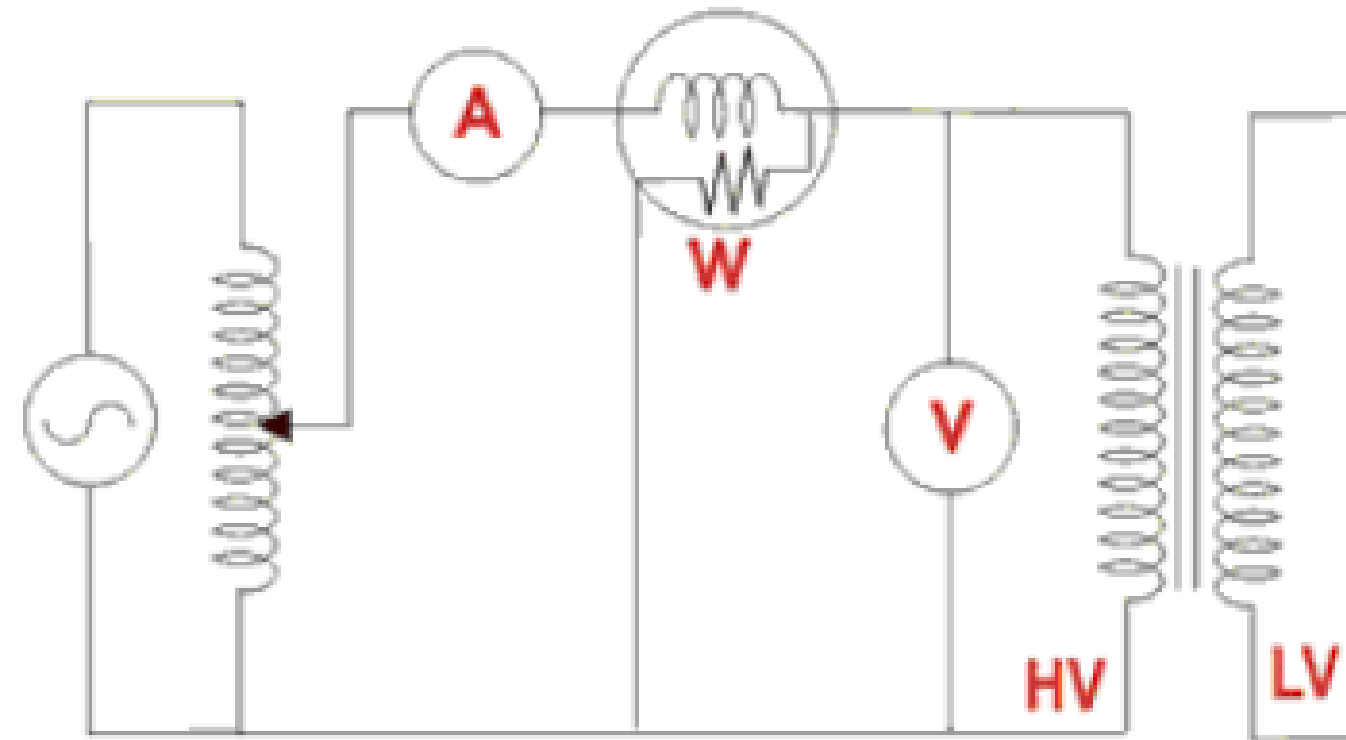
If,  $Z_m$  is shunt branch impedance of transformer.

$$\text{Then, } Z_m = \frac{V_1}{I_e}$$

The **open circuit test on transformer** is used to determine core losses in transformer.



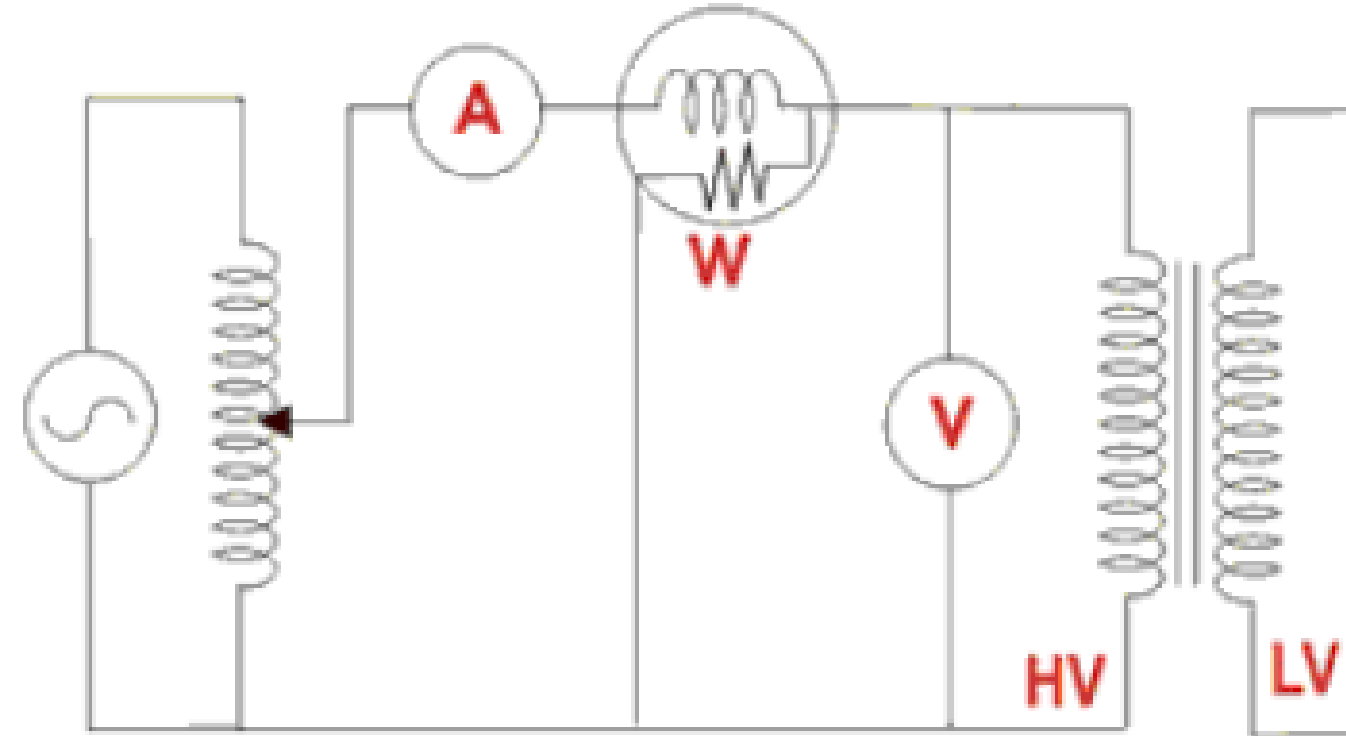
## SHORT CIRCUIT TEST ON TRANSFORMER



Short Circuit Test on Transformer

A voltmeter, wattmeter, and an ammeter are connected in HV side of the transformer. A low voltage of around 5-10% is applied to that HV side with the help of a variac (i.e. a variable ratio auto transformer). We short-circuit the LV side of the transformer. Now with the help of variac applied voltage is slowly increased until the wattmeter, and an ammeter gives reading equal to the rated current of the HV side.

# SHORT CIRCUIT TEST ON TRANSFORMER

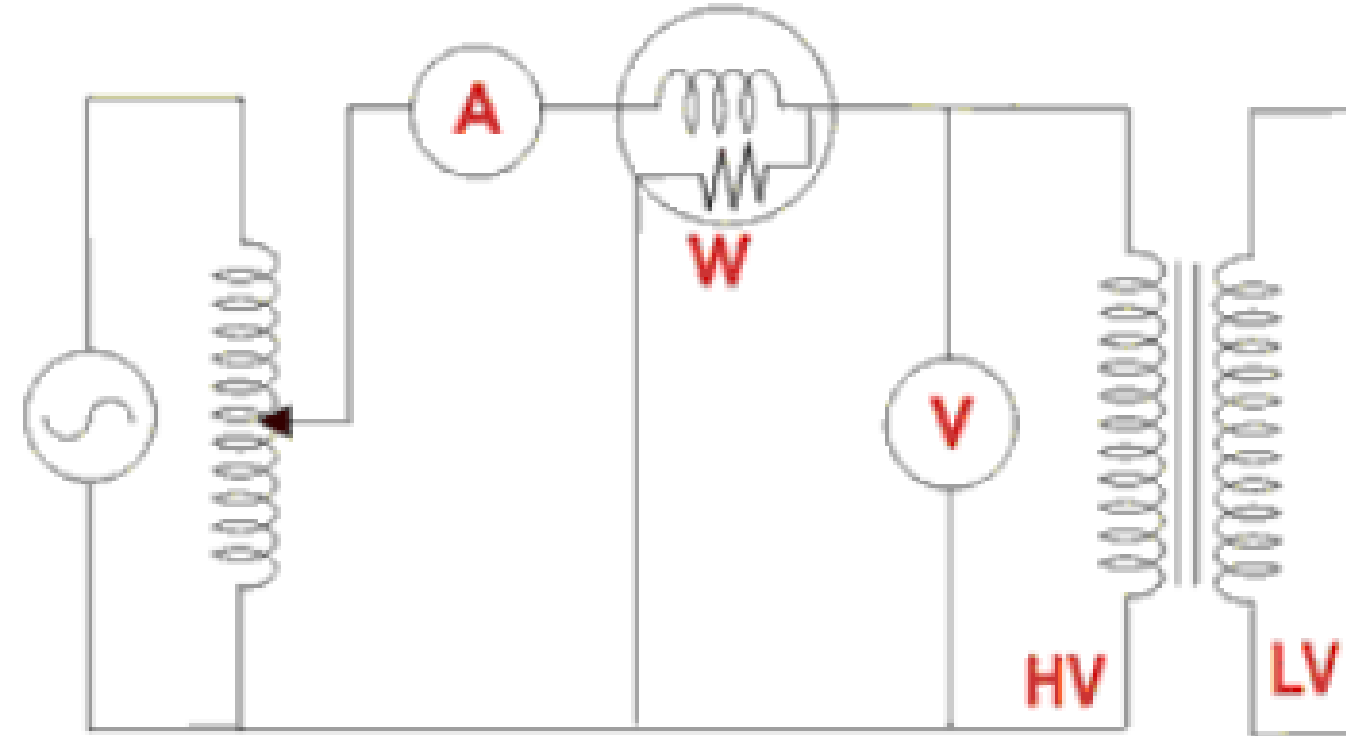


Short Circuit Test on Transformer

After reaching the rated current of the HV side, we record all the three instrument readings (Voltmeter, Ammeter and Watt-meter readings). The ammeter reading gives the primary equivalent of full load current  $I_L$ . As the voltage applied for full load current in a short circuit test on the transformer is quite small compared to the rated primary voltage of the transformer, the core losses in the transformer can be taken as negligible here.



# SHORT CIRCUIT TEST ON TRANSFORMER



Short Circuit Test on Transformer

Voltmeter reading is  $V_{sc}$ . The watt-meter reading indicates the input power during the test. As we have short-circuited the transformer, there is no output; hence the input power here consists of copper losses in the transformer. Since the applied voltage  $V_{sc}$  is short circuit voltage in the transformer and hence it is quite small compared to the rated voltage, so, we can neglect the core loss due to the small applied voltage.

## SHORT CIRCUIT TEST ON TRANSFORMER

The wattmeter reading can be taken as equal to copper losses in the transformer.  
Let us consider wattmeter reading is  $P_{sc}$ .

$$P_{sc} = R_e I_L^2$$

Where,  $R_e$  is equivalent resistance of transformer.

If,  $Z_e$  is equivalent impedance of transformer.

$$\text{Then, } Z_e = \frac{V_{sc}}{I_L}$$

Therefore, if equivalent reactance of transformer is  $X_e$ .

$$\text{Then, } X_e^2 = Z_e^2 - R_e^2$$

The **short-circuit test of a transformer** is used to determine copper losses in the transformer at full load

## VOLTAGE REGULATION OF TRANSFORMER

$$\% \text{ Regulation} = \frac{V_{\text{no-load}} - V_{\text{full-load}}}{V_{\text{full-load}}} \times 100$$

Where

$V_{\text{no-load}}$  is the no-load voltage and

$V_{\text{full-load}}$  is the full-load voltage.

# VOLTAGE REGULATION OF TRANSFORMER

$$\eta = \frac{\text{output power}}{\text{input power}} = \frac{\text{output power}}{\text{output power} + \text{losses}}$$

$$\eta = \frac{\text{output power}}{\text{output power} + \text{iron losses} + \text{copper losses}}$$

$$\eta = \frac{V_2 I_2 \cos\phi_2}{V_2 I_2 \cos\phi_2 + P_i + P_c}$$

Where,

$V_2$  – Secondary terminal voltage

$I_2$  – Full load secondary current

$\cos\phi_2$  – power factor of the load

$P_i$  – Iron losses = hysteresis losses + eddy current losses

$P_c$  – Full load copper losses =  $I_2^2 R_{es}$

*Thank  
You*