CHAPTER THREE:

Transformers

OPEN CIRCUIT & SHORT CIRCUIT

TEST ON SINGLE – PHASE TRANSFORMER

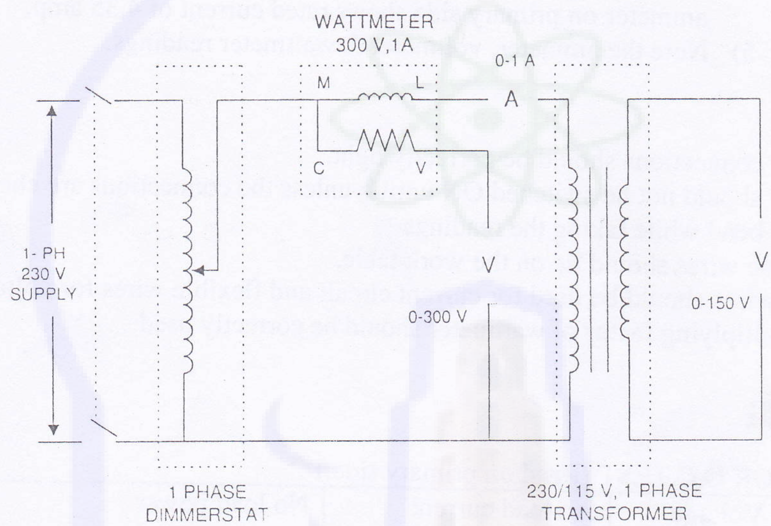
Apparatus: 1) 230/115V, 1KVA Single Phase transformer (1No.)
2) 0-250V, Single Phase dimmerstat (1No.)

FOR O.C. TEST
3) Voltmeter (0-300 V) (0-150 V) AC. each 1 No.
4) Ammeter (0-1 A) AC, 1 No.
5) Wattmeter (300V, 1A) 1No.

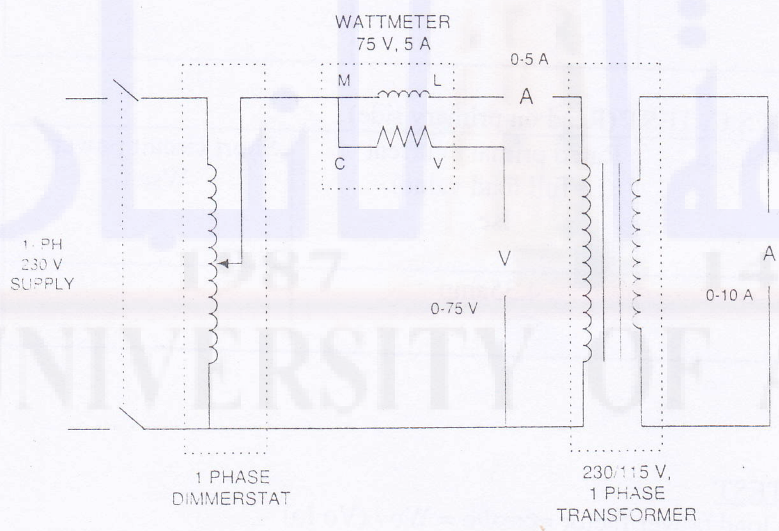
FOR S.C. TEST
6) Voltmeter (0-75 V.) AC. 1No.
7) Ammeter (0-5 A), (0-10 A) Ac. 1 each.
8) Wattmeter (75 V, 5 A) 1No.

Circuit Diagram:

FOR O.C. TEST.



FOR S.C. TEST.



Theory: It should cover the following
1) Purpose of O.C. & S.C. test.
1) Brief explanation about connection diagram.
2) Simplified equivalent circuit of a transformer and its parameters.

3) Formulae for efficiency and regulation.
4) Formulae for voltage drop for different power factor loads.

Procedure:

FOR O.C. TEST

1) Connect the circuit as shown.
2) Ensure that the dimmerstat Position is at zero.
3) Switch on the single phase AC. Supply.
4) Apply rated voltage of 230V, to the primary side of transformer.
5) Note the ammeter, voltmeter and wattmeter readings.

FOR S.C. TEST

1) Connect the circuit as shown.
2) Ensure that the dimmerstat position is at '0' (zero).
3) Switch on the single phase AC. Supply.
4) Slowly increase the output voltage of the dimmerstat till the ammeter on primary side shows rated current of 4.35 amp.
5) Note the ammeter, voltmeter & wattmeter readings.

Precautions:

1) All the connections should be perfectly tight.
2) Supply should not be switched ON until& unless the connections are checked by the teacher.
3) Do not bend while taking the readings
4) No loose wires should lie on the work table.
5) Thick wires should be used for current circuit and flexible wires for voltage circuits.
6) The multiplying factor of wattmeter should be correctly used.

Observations:

FOR O.C.TEST (Read on primary side.)

Rated input Voltage V_0	No load current I_0	No load power W_0
230V		

FOR S.C. TEST (Read on primary side)

Short circuit voltage Vsc	Rated primary current (i.e full load value) Isc	Short circuit power Wsc
	4.35amp	

Calculations:

FOR O.C. TEST

No load power factor =cosΦo = Wo / (Vo Io)

Magnetising component of Io = Iμ = Io sinΦo amps.

Core loss component of Io = Ic = Io cosΦo amps.

Core loss resistance Ro = Vo/ Ic ohm.

Magnetising reactance Xo = Vo/ Iμ ohms.

Core loss in transformer at any load = Wo

FOR S.C. TEST

Short circuit power factor $\cos\Phi_{sc} = W_{sc} / (V_{sc} I_{sc})$

Short circuit impedence $Z_{sc} = V_{sc} / I_{sc}\ \Omega$

Short circuit resistance $R_{sc} = W_{sc} / I_{sc}^2\ \Omega$

Short circuit reactance $X_{sc} = \sqrt{Z_{sc}^2 - R_{sc}^2}\ \Omega$

Copper loss in transformer at full load = W_{sc} watts.

Copper loss in transformer at half full load = $W_{sc}/4$ watts.

EFFICIENCIES:

1) At full load and at 0.8 power factor

$$\eta = \frac{\text{Full load kVA} \times 10^3 \times \cos\Phi \times 100}{\text{Full load KVA} \times 10^3 \times \cos\Phi + \text{core loss} + \text{copper loss at full load}}$$

2) All half full load and U.P.F.

$$\eta = \frac{\text{Half load KVA} \times 10^3 \times \cos\Phi \times 100}{\text{Half load KVA} \times 10^3 \times \cos\Phi + \text{core loss} + \text{copper loss at half load}}$$

REGULATIONS:

1) At full load and 0.8 power factor lagging.

Voltage drop = $I_{sc} (R_{sc} \cos\Phi + X_{sc} \sin\Phi)$

$$\%\ \text{Regulation} = \frac{\text{Voltage drop} \times 100}{\text{Rated primary voltage } (V_o)}$$

2) At full load and 0.8 power factor leading.

Voltage drop = $I_{sc} (R_{sc} \cos\Phi - X_{sc} \sin\Phi)$

$$\%\ \text{Regulation} = \frac{\text{Voltage drop} \times 100}{\text{Rated primary voltage } (V_o)}$$

3) At full load and U.P.F.

Voltage drop = $I_{sc} R_{sc} \cos\Phi$

$$\%\ \text{Regulation} = \frac{\text{Voltage drop} \times 100}{\text{Rated primary voltage } (V_o)}$$

Equivalent Circuit:

Draw simplified equivalent circuit showing calculated values of all parameters on it.

Result: - Full load efficiency at 0.8 p.f. =

Full load efficiency at U.P.F. =

Full load regulation at 0.8 lagging p.f. =

Full load regulation at 0.8 leading p.f. =

Full load regulation at U.P.F. =

R_o = ; X_o =

R_{sc} = ; X_{sc} =

Viva Questions: -

Q.1. What is the significance of O.C. & S.C. test?

Q.2. Why h.v. winding is kept open during O.C. test and 1.v. winding is shorted during S.C. test in case of large transformers?

Q.3. In O.C. test, a voltmeter is connected across secondary winding and still it is called as O.C. test. Why?

Q.4. What will happen if dc supply instead of ac supply is applied to a transformer?

Q.5. Which is the alternate method for finding efficiency and regulation of a transformer other than O.C. & S.C. tests ? What are their advantages over each other?

Q.6. What is the importance of equivalent circuit?

Q.7. Why regulation of transformer is negative for leading p.f. load?

Q.8. " The wattmeter reading during O.C. test is considered as core loss while wattmeter reading during S.C. test is considered as copper loss" Justify.