EXPERIMENT NO. 9

Objective: To perform Open circuit (OC) and Short circuit (SC) Test on single phase transformer.

Apparatus Required:

For OC Test:

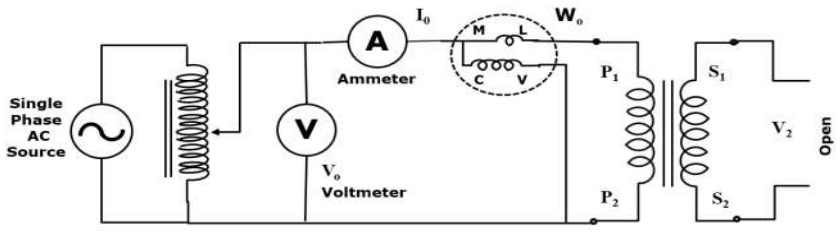
Sr. No.	Apparatus	Quantity	Range/ Remark
1	Single phase AC supply	**1**	**(……..) V**
2	Variac	**1**	**(i/p-230V,o/p-0-270V,15A)**
3	Single phase Transformer	**1**	2KVA,i/p-0-230-119-115V,o/p-0-230V,i/p and o/p-current-8.7A)
4	Wattmeter	**1**	**(…….)W**
5	AC Voltmeter	**1**	**(……..…)V**
6	AC Ammeter	**1**	**(……)A**
7	Connecting wires	**--**	**--**

For SC Test:

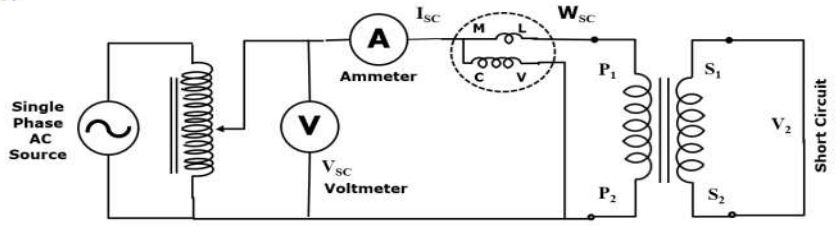
Sr. No.	Apparatus	Quantity	Range/ Remark
1	Single phase AC supply	**1**	**(……..) V**
2	Variac	**1**	**(i/p-230V,o/p-0-270V,15A)**
3	Single phase Transformer	**1**	2KVA,i/p-0-230-119-115V,o/p-0-230V,i/p and o/p-current-8.7A)
4	Wattmeter	**1**	**(…….)W**
5	AC Voltmeter	**1**	**(……..…)V**
6	AC Ammeter	**1**	**(……)A**
7	Connecting wires	**--**	**--**

Circuit Diagram:

OC Test



SC Test



Observation Table

A. Open Circuit Test:

S. No.	V_1 (Volts)	I_0 (A)	W_i (W)	$\cos\emptyset_0 = \frac{W_i}{V_1 I_0}$	$I_\mu = I_0 \sin\emptyset_0$	$I_w = I_0 \cos\emptyset_0$	$R_0 = \frac{V_1}{I_w}$	$X_0 = \frac{V_1}{I_\mu}$

B. Short Circuit Test:

S. No.	V_{sc} (Volts)	I_1 (A)	W_{cu} (W)	$Z_{01} = \frac{V_{sc}}{I_1}$ (Ω)	$R_{01} = \frac{W_{sc}}{I_1^2}$	$X_{01} = \sqrt{Z_{01}^2 - R_{01}^2}$

Theory: The performance of a transformer can be calculated on the basis of its equivalent circuit which contains four main parameters, the equivalent resistance R01 as referred to primary (or secondary R02),the equivalent leakage reactance X01 as referred to primary, the core-loss conductance G0 and the magnetizing susceptance B0.These constants or parameters can be easily determined by two test i.e. Open circuit test and Short circuit test.

Open Circuit Test: The purpose of this test is to determine no load loss or core loss and no load circuit paramters X_0 and R_0. One winding of the transformer (usually high voltage winding) is left open and other side (usually low voltage side) is connected to the AC supply with a wattmeter(W), voltmeter(V) and ammeter(A) as shown in figure. With rated voltage applied to the circuit, normal flux will be setup in the present case. With normal voltage applied to the primary, normal flux will be setup in the core, hence normal or rated iron losses will occur which is recorded by the wattmeter. As primary no load current I_0 is small, Copper loss is negligibly small in primary and will in secondary. Hence, the wattmeter reading represents practically the core loss under no load condition.

Let V_1 = Rated voltage, I_0 = no-load current and wattmeter reading W_i = Core loss

$$\cos \phi_0 = W_i / V_1 * I_0$$

$$I_\mu = I_0 \sin \phi_0 \text{ and } I_w = I_0 \cos \phi_0$$

$$X_0 = V / I_\mu \text{ and } R_0 = V / I_w$$

Short Circuit Test: For short circuit test, one winding usually the low voltage winding, is solidly short circuited by a thick conductor (or through an ammeter which may serve the additional purpose of indicating till rated load current) and the other side is connected as shown in the figure. A low voltage (usually 5 to 10% of normal primary voltage) at correct frequency (though for Copper losses it is not essential) is applied to the primary and is cautiously increased

till full load or rated current flows in both primary and secondary (as indicated by the respective ammeter). Since, in this test, the applied voltage is small percentage of the normal voltage, the mutual flux produced is also a small percentage of its normal value. Hence, core losses are very small with the result that the wattmeter reading represents the full load Copper loss for the whole transformer i.e., both primary Copper loss and secondary Copper loss.

Let V_{SC} = Short circuit voltage, I_1 = rated current and wattmeter reading W_{cu} = rated Copper loss

$$R_{01} = W_{cu} / I_{SC}^2$$

$$Z_{01} = V_{SC} / I_1$$

$$X_{01} = \sqrt{Z_{01}^2 - R_{01}^2}$$

Procedure:

Open Circuit:

1. Connect the circuit as per fig 1.
2. Switch on the supply .
3. Increase the voltage to rated voltage with the help of variac.
4. Note down the readings of wattmeter, voltmeter, ammeter.

Short Circuit:

5. Connect the circuit as per fig 2 and short circuit the secondary windings.
6. Increase the voltage applied, slowly, so that the current flowing in the transformer winding equals the rated value.
7. Record the readings of the ammeter, voltmeter and wattmeter

Result:

1. For Open Circuit:

a. Iron losses (Wi) =

b. R_0 =

c. X_0 =

2. For Short Circuit:

a. Copper loss (W_{cu}) =

b. Equivalent Resistance (R_{01}) =

c. Equivalent Reactance (X_{01}) =

Precaution:

1. Connection should be tight and proper
2. While performing the short circuit test, the voltage applied should be initially set at zero and then increased slowly.