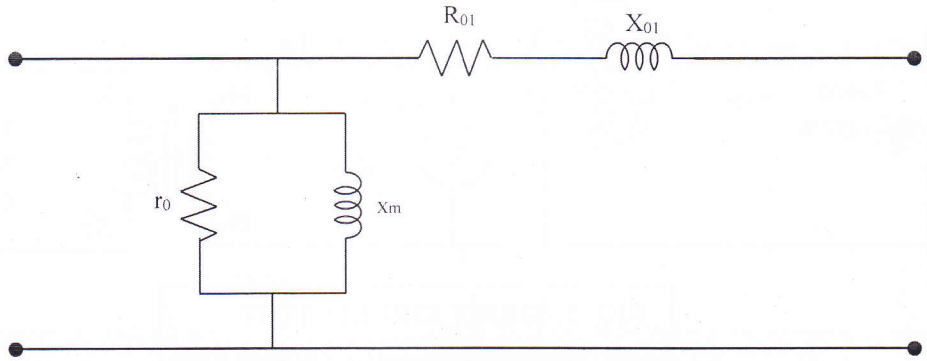
CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING
CHITTAGONG-4349, BANGLADESH.

Course No. EEE-184
Course Title: Electrical Drives Sessional

EXPT. NO. 05: DETERMINATION OF THE EQUIVALENT CIRCUIT PARAMETERS OF A TRANSFORMER AND CALCULATION OF EFFICIENCY AND REGULATION.

INTRODUCTION:

The approximate equivalent circuit of a transformer is given in the following figure-



The various parameters of this circuit can be determined by open circuit test and short circuit test. Various performance characteristics (such as regulation, efficiency) can be determined with the help of this circuit without actually loading the transformer. This experiment is designed to perform the open circuit and short circuit test. The transformer will be loaded with a certain RL load and regulation and efficiency will be experimentally measured. Obtained results will be compared with those from theoretical calculations.

OBJECTIVES:

The purpose of this experiment is-

1. To determine the iron or core loss of the transformer at rated voltage in open circuit test.
2. To determine the copper loss of the transformer at rated current in short circuit test.
3. To measure the winding resistance of the transformer.
4. To calculate the voltage regulation of the transformer.

APPARATUS:

1. Single phase transformer
2. DL 10015
3. DL 10030
4. DL 1060
5. Ammeter
6. Voltmeter
7. Wattmeter

EXPERIMENTAL SETUP:

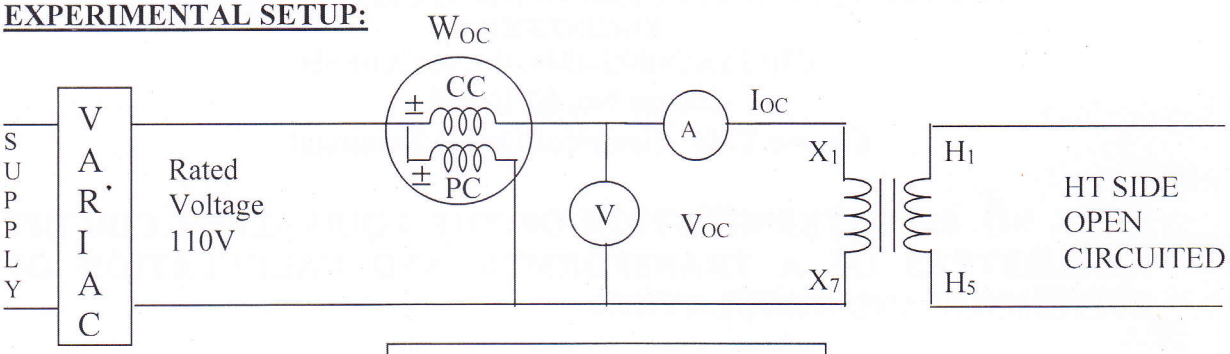


FIG. 1: OPEN CIRCUIT TEST

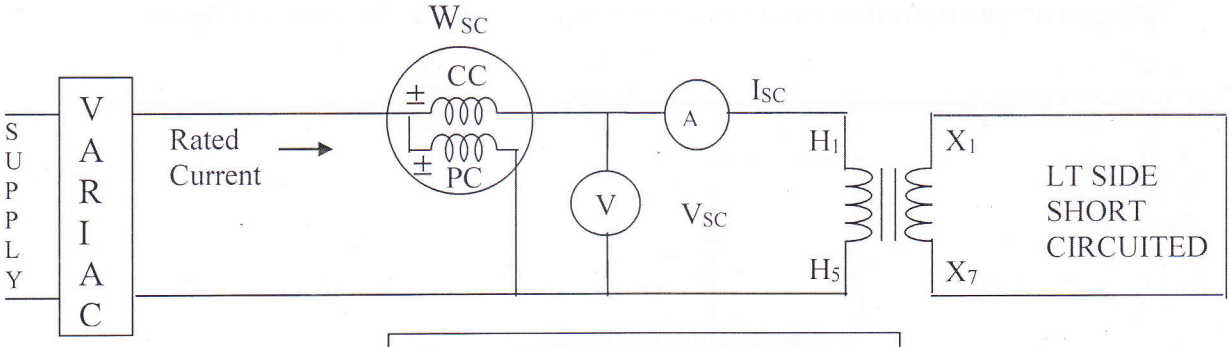


FIG. 2: SHORT CIRCUIT TEST

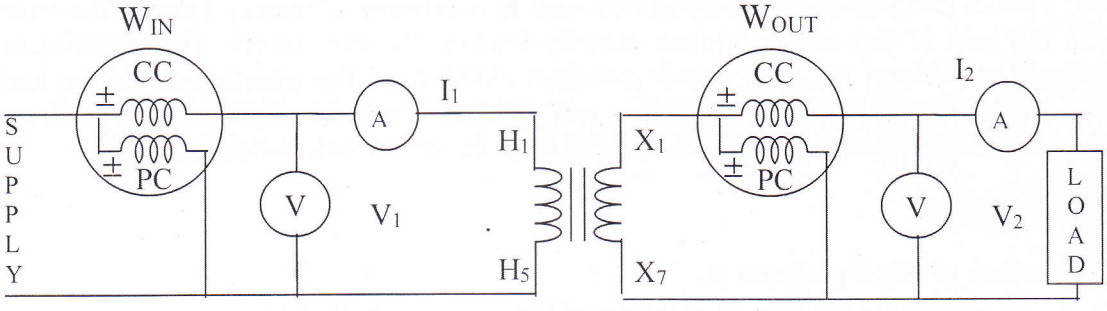


FIG. 3: LOADING TEST

PROCEDURE:

1) Open Circuit Test:: Complete connections as shown in the experimental setup. Apply rated voltage to secondary (Low Tension side) of the transformer. Note the readings of the ammeter, voltmeter & wattmeter.

2) Short Circuit Test: Complete connections as shown in the experimental setup. Gradually apply voltage across the primary (High Tension side) of the transformer until rated primary current flows through the ammeter. Quickly take the readings of the ammeter, voltmeter & wattmeter.

3) Loading Test : Load the secondary with an RL load and complete connections as shown the figure. Apply rated voltage across the HT side. Measure the secondary current, voltage and readings of the both wattmeters.

DATA:

Name plate data of the transformer:

KVA rating:
Voltage rating:

Data for open circuit test (referred to LT side):

Input power (W_{OC}), watts =
Input current (I_{OC}), amps =
Input power (V_{OC}), volts =

Data for short circuit test (referred to HT side):

Input power (W_{SC}), watts =
Input current (I_{SC}), amps =
Input power (V_{SC}), volts =

Data for loading test (referred to LT side):

Input power (W_{IN}), watts =
Output power (W_{OUT}), watts =
Output current (I_2), amps =
Output voltage(V_2), volts =

CALCULATIONS:

1) Core loss, $W_{CORE} = W_{OC}$ watt
2) Core loss resistance (referred to the HT side):
$$r_0 = ((V_{OC})^2 \times a^2)/W_{OC} \ \Omega$$
3) Magnetizing resistance (referred to the HT side):
$x_m = (V_{OC} \times a^2)/ I_{OC} \sin\phi_0$, where $\phi_0 = \cos^{-}(W_{OC}/ V_{OC}I_{OC})$
4) Copper loss, $W_{cu} = W_{SC}$
5) Equivalent resistance, $R_1 = W_{SC}/ I_{SC}^2$
6) Equivalent reactance, $X_1 = \sqrt{((V_{SC}/I_{SC})^2 - R_1^2)}$
7) Power factor of RL load:

$\cos\theta = (W_{OUT}/ V_2I_2)$

8) Voltage regulation:

$(E_2 - V_2)/ V_2 \times 100\ \%$

where, $E_2 = (V_2 \cos\theta + I_2r_2) + j(V_2 \sin\theta + I_2x_2)$

$r_2 = R_1/ a^2$ and $x_2 = X_1/a^2$

9) Efficiency :

$W_{OUT}/ W_{IN} = (V_2 I_2\cos\theta)/ (V_2 I_2\cos\theta + W_{CORE} + W_{IN})$

REPORTS:

1. Determine the equivalent circuit parameters of the transformer from the test data.
2. Using the equations given in the preceding part, determine efficiency and regulation of the transformer for the given RL load. Compare the results with those obtained experimentally.
3. What are the approximations of the short and the open circuit tests?
4. Why open circuit test is performed in the high tension side whereas short circuit test is performed in the low tension side?

QUIZ:

1. What are the main losses in a transformer?
2. What are the copper losses? How do they vary with the load current and why?
3. How do the iron losses vary with the flux density? Why do you take the as nearly constant in a transformer?
4. Derive the condition for which the voltage regulation is maximum.