Tutorial Sheet – 06 (Transformer)

1. A 1-phase, 10 kVA, 220/110 V, 60 Hz transformer is connected to a 220 V supply. It draws rated current at 0.8 power factor leading. Considering ideal transformer,

(a) Determine the kVA rating of the load.

(b) Determine the impedance of the load.

[Ans: (a) 10kVA, (b) $1.21\angle -36.87^\circ\ \Omega$]

2. A 2500/250 V, 500kVA, 60 Hz transformer has the following values:

$r_1 = 0.1\ \Omega$, $x_{L1} = 0.3\ \Omega$, $r_2 = 0.001\ \Omega$, $x_{L2} = 0.003\ \Omega$

When the transformer is loaded to its capacity (at u.p.f.) with rated voltages at the terminals and used as a step-down transformer, find the ratio of primary and secondary induced voltages.

[Ans: 9.901]

3. A 1-phase transformer has 400 primary and 1000 secondary turns. The net cross-sectional area of the core is 60 cm^2. The primary winding is connected to a 500V, 50 Hz. The mean length of the flux path in the core is 0.7m. Determine the flux density (peak) of the core and the magnetizing current. The B-H curve of the material of the core is provided below in a tabular form.

B(Wb/m^2)	0.1	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.2	1.3
H(AT/m)	62.5	125	187.5	250	312.5	375	500	625	750	900	1200	1500

[Ans: 0.94 Wb/m^2, 1.18 A]

4. For the transformer shown in Fig. Q5, N_{EF} = 600, N_{AB} =150 and N_{CD} =300 turns. Also the load resistances R_{AB} = 30Ω and R_{CD} = 15Ω. The voltage applied to the primary is 16V. Considering the transformer to be ideal, calculate

(a) Total load impedance reflected to the primary.

(b) Total current drawn from the supply.

[Ans: (a) 53.3 Ω, (b) 0.3 A]

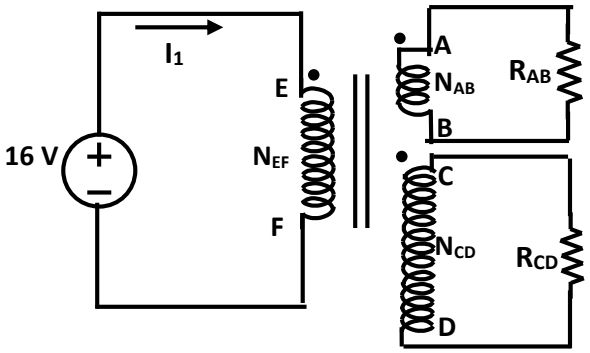

Fig. Q5

5. Reconnect the windings of a 1-phase, 3 kVA, 240/120 V, 60 Hz transformer so that it can supply a load at 330 V from a 110 V supply.

(a) Show the connection

(b) Determine the maximum kVA the reconnected transformer can deliver (for the given supply voltage). [Ans: 4.125 kVA]

6. A 1-phase, 440 V, 8 kW load having a lagging power factor of 0.8 is supplied through a feeder of impedance (0.15 + *j*0.4) Ω and a 1-phase, 10 kVA, 220/440 V, 60 Hz transformer. The equivalent leakage impedance of the transformer referred to high voltage side is (0.2875 + *j*1.125) Ω. Determine the voltage at the sending end of the feeder.

[Ans: 247.34∠4.34° V]

7. A 20 kVA, 2500/500 V, single-phase transformer has the following parameters:

HV Winding: $r_1 = 8\ \Omega$, $x_1 = 17\ \Omega$; LV Winding: $r_2 = 0.3\ \Omega$, $x_2 = 0.7\ \Omega$.;

The supply Voltage is held constant at 2500 V. Find the voltage regulation at full load for (a) 0.9 pf lag (b) 0.9 pf lead.

[Ans: (a) 10.57%, (b) 0.396%]

8. A 1-phase, 25 kVA, 2300/230 V transformer has the following parameters:

$Z_{eq,\mathrm{H}} = (4.0 + j5.0)\ \Omega$, $R_{c,\mathrm{L}} = 450\ \Omega$; $X_{m.\mathrm{L}} = 300\ \Omega$

The transformer is connected to a load with variable power factor. Determine the worst-case voltage regulation for full load output.

[Ans: 3.03%]

9. A 4 kVA, 200/400 V, 50 Hz, single-phase transformer gave the following test figures:

No Load: LV Side: 200 V, 0.7 A, 60 W; SC Test: HV Side: 9V, 6A, 21.6 W;

a) Find the magnetizing current and the iron loss component of current.

b) Calculate the secondary terminal voltage on full load at power factors of 0.8 lag and 0.8 lead.

[Ans: (a) 0.63 A, 0.3 A, (b) 387.05 V, 403.7 V]

10. A 1-phase, 10 kVA, 2400/240 V, 60 Hz transformer has the following characteristics:

Core loss at full voltage = 100 W, Copper loss at half load = 60 W.

(a) Determine the efficiency of the transformer when it delivers full load at 0.8 power factor lagging.

(b) Determine the per unit rating at which the transformer efficiency is maximum. Determine this efficiency if the load power factor is 0.9.

(c) The transformer has the following load cycle:

No load for 6 hours

70% of full load at 0.8 power factor for 10 hours

90% of full load at 0.9 power factor for 8 hours

Determine the all-day efficiency of the transformer.

[Ans: (a) 95.92%, (b) 0.6455, 96.67%, (c) 95.93%]