Electrical Technology (EE11003)
Electrical Engineering Department, Indian Institute of Technology Kharagpur
Tutorial 5 (Autumn 23-24)

1. A 1-phase transformer has 400 primary and 1000 secondary turns. The net cross-sectional area of the core is 60cm^2. If the primary winding be connected to a 50-Hz at 500V, calculate (i) the peak value of the flux density in the core, and (ii) the voltage induced in the secondary winding.

[Ans: (i) 0.94Wb/m^2; (ii) 1250V]

2. A 1-phase, 50Hz, core-type transformer has square cores of 20-cm side. The permissible maximum density is 1Wb/m^2.Calculate the numbers of turns on the high- and low- voltage sides for a 3000/220-V ratio. [Ans: 338, 25]

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 50Hz supply of 500V. 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.

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

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

4. 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∠-36.87° Ω]

5. 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. Estimate the worst-case voltage regulation for full load output. [Ans: 3.03%]

6. A single phase transformer has voltage regulation of 6% and 6.6% for lagging power factors of 0.8 and 0.6 respectively. Full load ohmic loss is equal to iron loss. Calculate the lagging power factor at which full load voltage regulation is maximum and the full load efficiency at unity power factor.

[Ans: 0.4472, 94.34%]

7. During no-load test of a transformer, a voltage of $v = 200\sin(314t)$ is applied and the resulting current is $i = 3\sin(314t\text{-}60°)$. Determine the core loss and rms value of the no-load current.

[Ans: 150 W, 2.12 A]

8. 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]

9. The maximum efficiency of a 50 kVA transformer is 97.4% and occurs at 90% of full load and at unity power factor. Calculate the efficiency at full load and with 0.8 lagging power factor.

[Ans: 96.75%]