Department of Electrical Engineering, IIT Bombay
EE111 : Introduction to Electrical Systems
Assignment 6

1. A 1-phase transformer has 400 primary and 1000 secondary turns. The net cross-sectional area of the core is 60 sq cm. If the primary winding is connected to a 50 Hz supply at 520 V, calculate (a) the max ux density in the core, (b) the voltage induced in the secondary winding. [Ans: 0.976 Wb/sq m, 1300 V]

2. The maximum ux density in the core of a 250/3000 volts, 50 Hz 1-Phase transformer is 1.2 Wb/sq m. If the emf per turn is 8 V, determine (a) primary and secondary turns, (b) area of the core. [Ans: 32, 375, 0.01 sq m]

3. A 50 kVA, 4400/220 V transformer has $R_1 = 3.45\Omega$, $X_1 = 5.2\Omega$, $R_2 = 0.009\Omega$, $X_2 = 0.015\Omega$. Calculate (a) equivalent resistance and reactance as referred to primary, (b) equivalent resistance and reactance as referred to secondary, (c) total Copper loss using equivalent resistances as referred to each side.[Ans: 7.05 Ω, 11.2 Ω, 0.0176 Ω, 0.028 Ω, 910 W]

4. A transformer has 800 primary and 200 secondary turns. When the load current on the secondary is 80 A at 0.8 p.f. lagging, the primary current is 25 A at 0.707 p.f. lagging. Determine the no load current of the transformer and its phase angle with respect to the voltage.[Ans: 5.93 A, 73.30]

5. Data refer to primary of 1-phase transformer is: turn ratio= 19.5:1 , $R_1 = 25\Omega$, $X_1 = 100\Omega$, $R_2 = 0.06\Omega$, $X_2 = 0.25\Omega$. No-load current= 1.25A leading the flux by 30°. The

secondary delivers 200 A at a terminal voltage of 500V and p.f. of 0.8 lagging. Determine the primary applied voltage, primary p.f. and effeciency.[Ans:11540∠186.70° V, 0.698 lag, 86.74%]

6. Calculate the regulation of a transformer in which the percentage resistance drop is 1% and percentage reactance drop is 5% when the p.f is (a) 0.8 lagging, (b) unity and (c) 0.8 leading.[Ans: 3.8%, 1%, -2.2%]

7. When a transformer is connected to a 1 kV, 50 Hz supply the core loss is 1 kW, of which 650 is hysteresis and 350 is eddy current loss. If the applied voltage is raised to 2 kV and frequency to 100 Hz, find the new core losses.[Ans: 2700 W]

8. The primary and secondary windings of a 30 kVA, 6000/230 V, 1-ph transformer have resistances of 10 ohm and 0.016 ohm respectively. The reactance of the transformer referred to the primary is 34 ohm. Calculate the primary voltage required to circulate full load current when the secondary is short circuited. What is the power factor on short circuit.[Ans: 200 V, 0.52 lag]

9. The effeciency of a 1000 kVA, 110/220 V, 50 Hz, 1-ph transformer is 98.5% at half full load at 0.8 p.f. leading and 98.8% at full load at unity p.f. Determine (a) iron loss (b) full load copper loss and (c) maximum effeciency at UPF.[Ans: 4.073 kW, 8.073 kW, 98.9%]

10. A short circuit test when performed on the h.v. side of a 10 kVA, 2000/400 V 1-ph transformer, gave the following data: 60 V, 4A, 100 W. If the l.v. side is delivering full load current at 0.8 p.f. lag and at 400 V, find the voltage applied to h.v. side.[Ans: 2067 V]

11. At 600 kVA, 1-ph transformer when working at UPF has an effeciency of 92% at full load and also at half load. Determine its effeciency when it operates at UPF and 60% of full load.[Ans: 96.5%]

12. A 10 kVA, 5000/440 V, 25 Hz 1-ph transformer has copper, eddy current and hysteresis losses of 1.5, 0.5 and 0.6 percent of output on full load. What will be the percentage losses if the transformer is used on a 10 kV, 50 Hz system keeping the full load current constant. Compare the full load effeciency for the two cases.(Assume UPF operation)[Ans: 0.75%, 1%, 0.6%, 87.4%, 97.7%]