Homework 3

EE-306 – Electromechanical Devices - Semester 162

Submission Deadline: 29 March 2017 (in class)

Note: You must submit this cover page along with your solution

Student Name	ID	Sr. #	Section

Total Marks Obtained	/

Problem 1

A single phase, two-winding transformer has 1000 turns on the primary and 500 turns on the secondary. The primary winding is connected to a 220 V supply and the secondary winding is connected to a 5 kVA load. The transformer can be considered ideal.

(a) Determine the load voltage

(b) Determine the load impedance

(c) Determine the load impedance referred to the primary

Problem 2

A single-phase distribution transformer of 100 kVA, 1000/100 V, 60 Hz has been tested for open and short circuit tests and the following data are recorded:

Test	**Voltage (V)**	**Current (A)**	**Power (W)**
Open-Circuit (Heavy Voltage Side Open)	100	6	400
Short-Circuit (Low Voltage Side Shorted)	50	100	1800

(a) Derive and draw the approximate equivalent circuit of this transformer referred to the high-voltage side. Label the circuit clearly with all given and calculated variables.

(b) Determine the voltage regulation at full load with 0.6 PF leading, and draw the corresponding phasor diagram.

Problem 3

A single-phase distribution transformer of 30 kVA, 8000/230V, 60 Hz, has equivalent series impedance $20 + j100\ \Omega$ referred to its primary side. The components of the excitation branch referred to the primary side are $R_C = 100$ kΩ and $X_m = 20$ kΩ.

(a) If the primary voltage is 7967 V and the load impedance is $Z_L = 2.0 + j0.7\ \Omega$:

Determine the secondary voltage of the transformer

Determine voltage regulation of the transformer

(b) If the load (as given in part (a) above) is disconnected and a pure capacitor of $-j3.0\ \Omega$ is connected instead:

Determine the secondary voltage of the transformer

Determine voltage regulation of the transformer

(c) What have you observed from the results of Part (a) and (b) above? Comment briefly.

Problem 4

A 150 kVA, 2400/240 V transformer has the following parameters referred to the primary side: $R_{eq} = 0.5\ \Omega$ and $X_{eq} = 1.5\ \Omega$. The shunt magnetizing impedance is very large and can be neglected. At full load, the transformer delivers rated kVA at 0.85 PF lagging and the secondary voltage is 240 V.

Determine the efficiency of the transformer assuming core losses amount to 600 W.

Problem 5

A 1000 VA, 230/115 V single-phase transformer has a full load voltage regulation of -1.5 % when delivering load connected to its secondary terminals at 0.8 PF leading. The transformer gives an efficiency of 94.9 % when delivering full load at 0.8 PF lagging. The copper losses of the transformer at full load can be considered as 10.6 W. Neglect the shunt magnetizing reactance.

Determine & Draw the approximate equivalent circuit of the transformer referred to the high voltage side. (Put all parameters numerical values and variables on the circuit).

Problem 6

A single-phase transformer of 30 kVA, 2400/240 V, 60 Hz, has the following characteristics:

Core losses = 400 W
Copper losses at Full-Load = 1200 W

(a) Determine the efficiency of the transformer at 70% of rated output power with 0.7 PF leading

(b) Determine the output power at which **maximum efficiency** occurs

(c) Determine the value of **maximum efficiency**

(d) Determine the percentage of full load power where **maximum efficiency** occurs

!End of Homework Problems!