Homework 3

EE-306 – Electromechanical Devices - Semester 171

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

Student Name	ID	Sr. #	Section

Total Marks Obtained	/

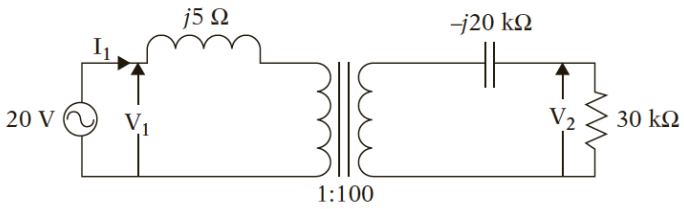

Figure 1: Figure of Problem 1.

Problem 1

An **ideal transformer** with the turns ratio 1:100 is connected in an electrical circuit as shown in Fig. 1. Calculate the following:

(a) Actual load voltage V_2

(b) Supply current I_1

Problem 2

The **peak** terminal voltage ($v_s(t)$) of secondary winding of a 100/200 V, 60 Hz transformer is:

$v_s(t) = 282.8 \ \sin 377t$ V.

If the **peak** secondary current of the transformer is:

$i_s(t) = 7.07 \sin(37736.87 - 36^o)$ A.

and if the impedances of this transformer **referred to the primary side** are:

$R_{eq} = 0.20\ \Omega$ and $X_{eq} = 0.75\ \Omega$

$R_C = 300\ \Omega$ and $X_M = 80\ \Omega$

Determine the primary current of this transformer using the approximate equivalent circuit referred to the primary side?

Problem 3

A single-phase transformer of 1000 VA, 230/115 V, 60 Hz has been tested to determine its equivalent circuit. The results of the tests are shown in Table 1.

Test	Voltage (V)	Current (A)	Power (W)
Open-Circuit (Primary Side)	230	0.45	30
Short-Circuit (Secondary Side)	19.1	8.7	42.3

Table 1: Table of Problem 3

(a) Find the equivalent circuit parameters referred to the **low-voltage side** of the transformer

(b) Draw the corrsponding equivalent circuit and label it clearly.

Problem 4

A single-phase, 300 kVA, 11 kV/2.2 kV, 60 Hz transformer has the following equivalent circuit parameters referred to the high-voltage side:

$R_{eq}(HV) = 2.784\ \Omega$ and $X_{eq}(HV) = 8.45\ \Omega$

$R_C(HV) = 57.6k\ \Omega$ and $X_M(HV) = 16.34k\ \Omega$

(a) Determine

(i) No-load current as a percentage of full load current

(ii) No-load power loss (i.e., core loss)

(iii) No-load power factor

(iv) Full-load copper loss

(b) If the load impedance on the low-voltage side is Z_{load} = $16\angle 60^o\ \Omega$, determine the **voltage regulation(VR)** using the approximate equivalent circuit.

Problem 5

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

$Z_{eq,HV} = 4 + j5\ \ \Omega$

$R_{C,LV} = 450\ \Omega$

$X_{M,LV} = 300\ \Omega$

(a) The transformer is connected to a load whose power factor varies. Determine the **worst-case voltage regulation** for full-load output. Draw a phaser diagram to explain.

(b) Determine transformer's efficiency when it delivers full load at rated voltage and 0.85 power factor lagging.

(c) Determine the percentage loading of the transformer at which the **maximum efficiency** occurs, and calculate this **maximum efficiency** if the power factor is 0.85 and load voltage is 230 V.

Problem 6

A single-phase, 10 kVA, 2400/240 V, 60 Hz distribution transformer has the following characteristics:
Core loss at **full voltage** = 100W
Copper loss at **half load** = 60W

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

!End of Homework Problems!