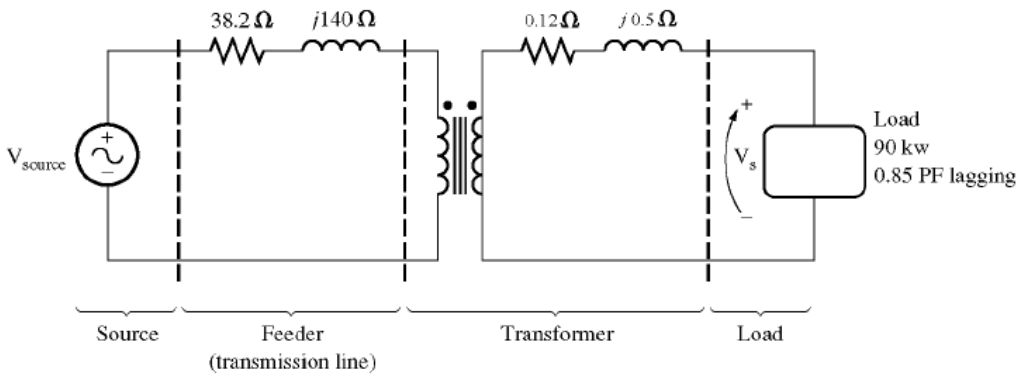
EEE3352 ASSIGNMENT NO.4

1. A single-phase transformer rated 1.2 kV/120 V, 7.2 kVA has primary-referred parameters $R_1=r_1+a^2r_2=1.0\ \Omega$ and $X_1=x_1+a^2x_2=4.0\ \Omega$. At rated voltage its core loss may be assumed to be 40 W for all values of the load current. (a) Determine the efficiency and regulation of the transformer when it delivers 7.2 kVA at $V_2=120$ V and power factor of (i) 0.8 lagging, (ii) 0.8 leading. (b) For a given load voltage and power factor it can be shown that the efficiency of a transformer attains its maximum value at the kVA load level which makes the I^2R winding losses equal to the core loss. Using this result, determine the maximum efficiency of the above transformer at rated voltage and 0.8 power factor, and the kVA load level at which it occurs.
2. A single-phase transformer rated 1.2 kV/120 V, 7.2 kVA yields the following test results:

   Open-circuit test (primary open): Voltage $V_2=120$ V; Current $I_2=1.2$ A; Power $W_2=40$ W.
   Short-circuit test (secondary shorted): Voltage $V_1=20$ V; Current $I_1=6.0$ A; Power $W_1=36$ W.
   Determine (a) the parameters $R_1=r_1+a^2r_2$, $X_1=x_1+a^2x_2$, G_c, and B_m referred to the primary side. (b) the values of the above parameters referred to the secondary side. (c) the efficiency of the transformer when it delivers 6 kVA at 120 V and 0.9 power factor.
3. The secondary winding of a transformer has a terminal voltage of $v_s(t) = 282.8 \sin 377t$ V. The turns ratio of the transformer is 50:200 ($a = 0.25$). If the secondary current of the transformer is $i_s(t) = 7.07 \sin (377t - 36.87°)$ A, what is the primary current of this transformer? What are its voltage regulation and efficiency? The impedances of this transformer referred to the primary side are

$$R_{eq} = 0.05\ \Omega \qquad R_C = 75\ \Omega$$
$$X_{eq} = 0.225\ \Omega \qquad X_M = 20\ \Omega$$

4. A single-phase power system is shown in the figure below. The power source feeds a 100-kVA 14/2.4-kV transformer through a feeder impedance of 38.2 + j140 Ω. The transformer's equivalent series impedance referred to its low-voltage side is 0.12 + j0.5 Ω. The load on the transformer is 90 kW at 0.85 PF lagging and 2300 V.



(a) What is the voltage at the power source of the system?
(b) What is the voltage regulation of the transformer?
(c) How efficient is the overall power system?

5. A 12.4-kV single-phase generator supplies power to a load through a transmission line. The load's impedance is $Z_{load} = 500 \angle 36.87\,°\Omega$, and the transmission line's impedance is $Z_{line} = 60 \angle 60\,°\Omega$.

(a) If the generator is directly connected to the load, what is the ratio of the load voltage to the generated voltage? What are the transmission losses of the system?

(b) If a 1:10 step-up transformer is placed at the output of the generator and a 10:1 transformer is placed at the load end of the transmission line, what is the new ratio of the load voltage to the generated voltage? What are the transmission losses of the system now? (*Note*: The transformers may be assumed to be ideal.)

NOTE: ASSIGNMENT IS DUE ON 4th MAY, 2015