



ECSE 461 – Electric Machinery Winter 2009

Midterm Examination

- Instructions:*
- Attempt all questions.
 - Documents allowed: textbook, notes, assignments and tutorials
 - Calculator allowed: McGill Engineering standard calculator
 - Duration: 80 min

1. A resistive-inductive load draws 10 kW at a power factor of 0.75 lagging when connected to a 240 V, 60 Hz, supply.
 - (a) Assuming a series connection, find the values of the equivalent R and X in Ω .
 - (b) The load is connected to a 208 V, 60 Hz supply. Compute the line current and the power drawn by the load. Explain the differences with the values at 240 V.
 - (c) Compute the reactive power and reactance in Ω of the power factor correction capacitor required to increase the power factor to 0.95 with the 208 V applied. The capacitor is connected in parallel with the load. Give the new line current.
 - (d) Draw the V-I and P-Q diagrams for the uncompensated and compensated cases.

2. A three phase load draws 21 kW and 15 KVAR when connected to a 600 V, 60 Hz supply.
 - (a) Assuming a Y-connected load, compute the voltage and current in each phase. Find the line current.
 - (b) Assuming a Y-connected load, represented as a series connection, in each phase, find the values of the equivalent R and X per phase, in Ω .
 - (c) The same R-L load is connected in Δ to the same 600 V three-phase supply. Give the phase voltage and current. Find the line current. Compute the total power.
 - (d) Compare currents and powers for the Y and Δ connections. Find the value required for the equivalent R and X in the Δ connection to obtain the same power as in the Y connection.

3. A 20 kVA, 14.4 kV / 240 V, 60 Hz single-phase distribution transformer has the following parameters, in Ω referred to the respective windings: primary side: $R_p = 77.8$, $X_p = 351$, secondary side: $R_s = 0.021$, $X_s = 0.097$, $R_c = 240$, $X_m = 110$.
 - (a) Draw the equivalent circuit referred to the primary and indicate all values in Ω . The resistive and inductive series components are lumped; the magnetizing branch is set at the input of the primary side.
 - (b) An inductive load, consuming 14 kW at a power factor of 0.70 lagging, is connected to the secondary, assumed to be at 240 V. Find the input current and voltage at the primary side. Ignore the excitation branch. Compute the voltage regulation.
 - (c) Compute the transformer losses for the 14 kW, 0.7 power factor load. For the core losses, assume rated voltage at the primary side. Find the efficiency of the transformer.
 - (d) The secondary winding is short circuited through a 0.05 Ω resistance. Ignore the excitation current. Compute the short circuit current on the primary side, assuming rated voltage is applied. Indicate the short circuit current in % of rated current.