ECE 3364, Dr. Hebert, F 2016 HW 5 Due 9/29

Problem 1. Nilsson, 8th edition Problem 11.38

11.38 The total power delivered to a balanced three-phase load when operating at a line voltage of $6600\sqrt{3}$ V is 1188 kW at a lagging power factor of 0.6. The impedance of the distribution line supplying the load is $0.5 + j4\ \Omega/\phi$. Under these operating conditions, the drop in the magnitude of the line voltage between the sending end and the load end of the line is excessive. To compensate, a bank of Δ-connected capacitors is placed in parallel with the load. The capacitor bank is designed to furnish 1920 kVAR of magnetizing reactive power when operated at a line voltage of $6600\sqrt{3}$ V.

a) What is the magnitude of the voltage at the sending end of the line when the load is operating at a line voltage of $6600\sqrt{3}$ V and the capacitor bank is disconnected?

b) Repeat (a) with the capacitor bank connected.

c) What is the average power efficiency of the line in (a)?

d) What is the average power efficiency in (b)?

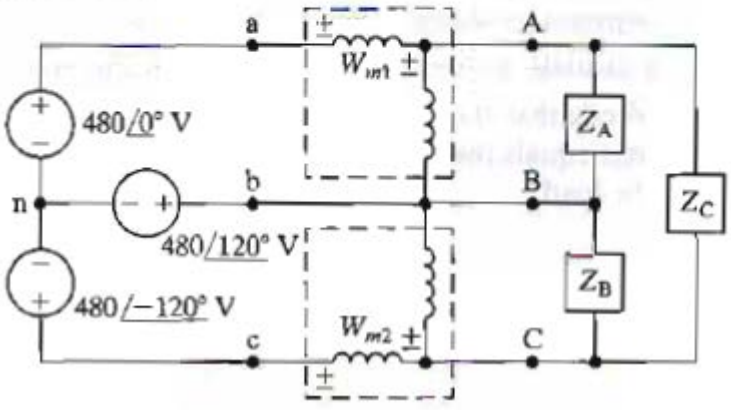
e) If the system is operating at a frequency of 60 Hz, what is the size of each capacitor in microfarads?

Problem 2. Nilsson, 8th edition Problem 11.48

11.48 a) Find the reading of each wattmeter in the circuit shown in Fig. P11.48 if $Z_A = 60\angle -30^\circ\ \Omega$, $Z_B = 24\angle 30^\circ\ \Omega$, and $Z_C = 80\angle 0^\circ\ \Omega$.

b) Show that the sum of the wattmeter readings equals the total average power delivered to the unbalanced three-phase load.

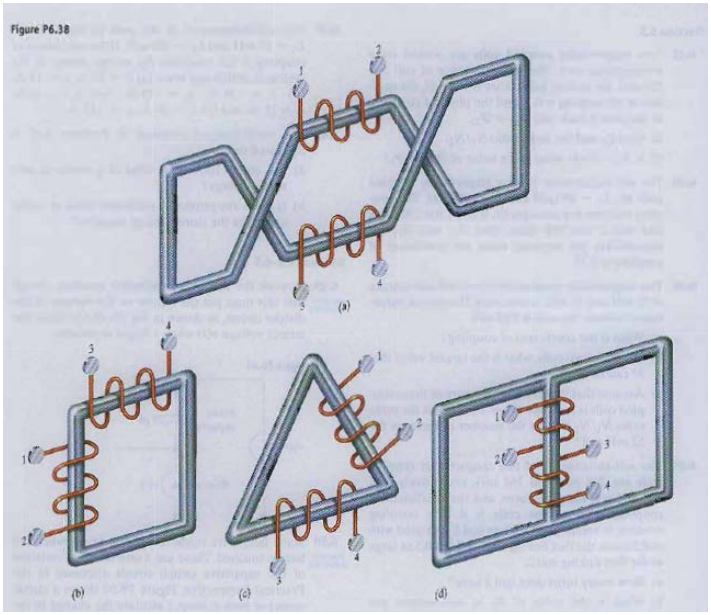
Figure P11.48



Use any method to solve the next problems

Problem 3. Nilsson, 8th edition Problem 6.38

6.38 The physical construction of four pairs of magnetically coupled coils is shown in Fig. P6.38. (See page 225.) Assume that the magnetic flux is confined to the core material in each structure. Show two possible locations for the dot markings on each pair of coils.



Problem 4. Nilsson, 8th edition Problem 6.45

6.45 The self-inductances of two magnetically coupled coils are 288 mH and 162 mH, respectively. The 288 mH coil has 1000 turns, and the coefficient of coupling between the coils is ½. The coupling medium is nonmagnetic. When coil 1 is excited with coil 2 open, the flux linking only coil 1 is 0.5 as large as the flux linking coil 2.

a) How many turns does coil 2 have?

b) What is the value of $\mathcal{P}_2$ in nanowebers per ampere?

c) What is the value of $\mathcal{P}_{11}$ in nanowebers per ampere?

d) What is the ratio (ϕ_{22}/ϕ_{12})?

Problem 5. Nilsson, 8th edition Problem 10.36

10.36 a) Find the average power delivered to the 40 Ω resistor in the circuit in Fig. P10.36.

b) Find the average power developed by the ideal sinusoidal voltage source.

c) Find Z_{ab}.

d) Show that the average power developed equals the average power dissipated.

Figure P10.36