Assignment Problems #4

Subject: **Basic Electrical Engineering** (Chapter 4: **Poly-Phase AC Circuit Analysis)**

1. Show by different methods that the sum of three phase e.m.f.s is always zero.

2. Three similar choke coils are connected in star to a 3-phase supply. If the line currents are 15 A, the total power consumed is 11 kW and the volt-ampere input is 15 kVA, find the line and phase voltages, the VAR input and the reactance and resistance of each coil.

[577.3 V; 333.3 V; 10.2 kVAR; 15.1 Ω; 16.3 Ω]

3. A 3-phase, delta-connected load, each phase of which has R = 10 Ω and X = 8 Ω, is supplied from a star-connected secondary winding of a 3-phase transformer each phase of which gives 230 V. Calculate (a) the current in each phase of the load and in the secondary windings of the transformer, (b) the total power taken by the load, and (c) the power factor of the load.

[(*a*) 31.1 A; 54 A (*b*) 29 kW (*c*) 0.78]

4. A 3-phase load consists of three similar inductive coils, each of resistance 50 Ω and inductance 0.3 H. The supply is 415 V, 50 Hz, Calculate (a) the line current (b) the power factor and (c) the total power when the load is (i) star-connected and (ii) delta-connected.

[(i) 2.25 A, 0.47 lag, 762 W (ii) 6.75 A, 0.47 lag, 2280 W]

5. Three 20 Ω non-inductive resistors are connected in star across a three phase supply the line voltage of which is 480 V. Three other equal non-inductive resistors are connected in delta across the same supply so as to take the same-line current. What are the resistance values of these other resistors and what is the current- flowing through each of them?

[60 Ω; 8A]

6. A three-phase, star-connected alternator supplies a delta-connected load, each phase of which has a resistance of 20 Ω and a reactance of 10 Ω. Calculate (a) the current supplied by the alternator (b) the output of the alternator in kW and kVA, neglecting the losses in the lines between the alternator and the load. The line voltage is 400 V.

[(a) 30.95 A (b) 19.2 kW, 21.45 kVA]

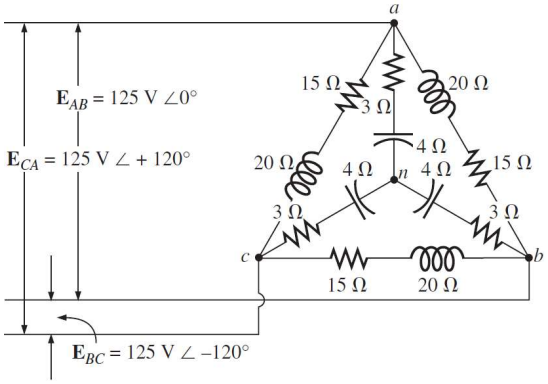
7. A balanced three-phase star connected load of 100 kW takes a leading current of 80 amp, when connected across a three-phase 1100 V, 50 Hz, supply. Find the circuit constants of the load per phase.

[Z = 7.94 Ω, R = 5.21 Ω, C = 531 μF]

8. Three identical impedances are connected in delta to a 3 φ supply of 400 V. The line current is 35 A and the total power taken from the supply is 15 kW. Calculate the resistance and reactance values of each impedance.

[12.25 Ω, 15.5 Ω]

9. Find the total watts, volt-amperes reactive, volt-amperes, and power factor of the system shown.



[3 kW, 998.7 VAR, 3161 VA, 0.949 (leading)]

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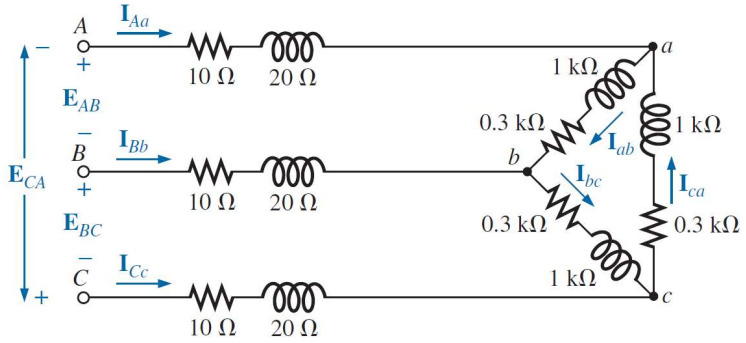
10. For the Δ-connected load in the network below;
a. Find the magnitude and angle of each phase current I_{ab}, I_{bc}, and I_{ca}.
b. Calculate the magnitude and angle of each line current I_{Aa} , I_{Bb} , and I_{Cc} .
c. Determine the magnitude and angle of the voltages E_{AB}, E_{BC}, and E_{CA}.

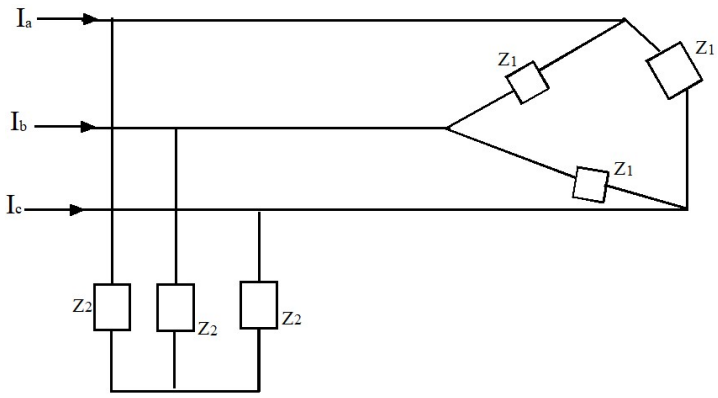


(a) I_{ab} = 15.33 ∠-73.30° A, -------, --------
(b) I_{Aa} = 26.55∠-103.30°, -------, --------
(c) E_{AB} = 17.01 kV ∠- 0.59°, -------, ------

11. A balanced delta-connected load having an impedance $\mathbf{Z_L}$ **= (300 + j210)** ohm in each phase is supplied from **400-V**, 3-phase supply through a 3-phase line having an impedance of $\mathbf{Z_s}$ **= (4 + j8)** ohm in each phase. Find the total power supplied to the load as well as the current and voltage in each phase of the load.

[951 W, 1.78 A, 216.9 V]

12. Two three phase loads are connected as shown below to a three phase, 200V supply where, $Z_1 = (6 - j8)\ \Omega$ and $Z_2 = (4 + j3)\ \Omega$. Calculate:
i) Phase and line currents in both the a) delta and b) wye load,
ii) Line currents I_a, I_b, and I_c, and
iii) Total average, reactive and apparent power drawn from supply.
(iv) P.f. of the system.



(i) a) $I_{\Delta\phi 1}$ = 20∠53.13° A, ---------, $I_{\Delta L1}$ = 34.64 ∠23.13°, ------ b) $I_{Y\phi 1} = I_{YL1}$ = 23.12 ∠-36.87°
(ii) $I_a = I_{\Delta L1} + I_{YL1}$, I_b = --------, I_c = ----------
(iii) 13614.41 W, 4789.19 VAR, 14432.2 VA, 0.943 leading

13. Describe the power measurement methods of 3-phase systems.