For Star-Delta problems, first make the circuit diagram and then apply the common properties of that particular type of circuit.

Assignment 2

1. A balanced Δ-connected load has an impedance of 864 – j252 Ω/phase. The load is fed through a line having an impedance of 0.5 + j4.0 Ω/phase. The line voltage at the terminals of the load is 120√3 V. Using $\overline{Vab}$ (load side) as reference, calculate
   a) Phase currents of load
   b) Line currents
   c) Sending end line voltage
   d) Complex Power at the load side and real power loss in the line.

   [Ans: *(a). 0.231∠16.26° A, 0.231∠-103.74° A, 0.231∠-223.74° A; (b). 0.4∠-13.74° A, 0.4∠-133.74° A, 0.4∠-253.74° A; (c) 207.42∠-0.762° V, 207.42∠-119.238° V, 207.42∠-239.238° V; (d). S=(138.24-j40.32) VA and real power loss = 0.24 W*]

2. For the given circuit (Fig.1), calculate the following, if $Z_1 = 3 + j4.0\ \Omega$, $Z_2 = 4 + j3.0\ \Omega$, $Z_3 = 5\ \Omega$. Neglect line
   impedance between load and source.
   a) Load phase currents
   b) Line currents
   c) Source phase currents

   [Ans: a) $\overrightarrow{I_{CA}}$=120∠-53.13° A, $\overrightarrow{I_{AB}}$=120∠-156.87° A, $\overrightarrow{I_{BC}}$=120∠120° A; b) $\overrightarrow{I_{aC}}$=239.57∠-56.565° A, $\overrightarrow{I_{bA}}$=188.79∠165° A, $\overrightarrow{I_{cB}}$=159.23∠71.565° A; C) $\overrightarrow{I_{ac}}$=120.12∠103.1° A, $\overrightarrow{I_{cb}}$=84.72∠-156.29° A, $\overrightarrow{I_{ba}}$=133.63∠-38.36° A

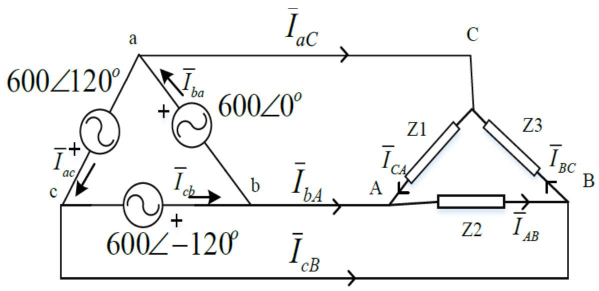

Fig. 1

3. A 3-phase, 415 V, 50 Hz supply is feeding an unbalance Y-connected load having phase-a impedance of 10 Ω, phase-b impedance is j10 Ω and phase-c impedance is –j10 Ω. The supply and load neutral points are not connected. Find the line currents.

Take care of the reference. Here if you take the V(ab) as reference then your answers will get shifted by -30*.

[Ans : I_a =41.5∠0° A, I_b =21.482∠-165° A, I_c =21.482∠165° A]

4. Repeat the above problem no.3, if the neutral of the load is connected to the neutral of the supply. What will be neutral wire current?

[Ans : I_a =23.96∠0° A, I_b =23.96∠150° A, I_c =23.96∠-150° A, I_n =-17.54∠0° A]

5. Three balanced 3-phase loads are connected in parallel. Load-1 is Y-connected with an impedance of (300 + j150) Ω/phase; load-2 is Δ-connected with an impedance of (3600-j2700) Ω/phase and load 3 is 450 kW at 0.8 pf lagging. The load is fed from a distribution line with line impedance of (1+j8) Ω/phase. The magnitude of phase voltage at load end of the line is 7.5kV. Calculate
   a) Total complex power at the sending end of the line.
   b) What percentage of the average power at the sending end of the line is delivered to the loads.

[Ans: *a) S = (997.26+ j553.08) kVA, b) 99.27%*]

6. The two-wattmeter method produces wattmeter readings P_1=1560W, P_2=2100W, when connected to a Delta connected load. The Line-Line voltage of the supply is 220 V. Calculate the phase impedance of the load.

[Ans: *Z = 38.44∠14.33° Ω*]

Formulas will change with star-delta and star-star. So, it's better to remember the properties and then apply them in the question.

7. The two wattmeter method is used to measure the power in three phase balanced load. Prove that the total reactive power supplied by the source is $Q = \sqrt{3}\,(W_2 - W_1)$.

8. The power in a three phase balanced load is measured using one wattmeter connected as shown in Fig. 2. Find the power measured by the wattmeter and its relation with the total real/reactive power of the load.

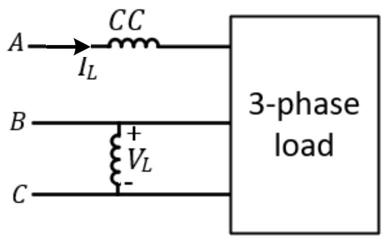

Fig. 2