Tutorial Sheet-4 (Three Phase System)

1. A high-voltage generator is connected to a 3-phase wye connected load through a transmission line. Each phase of the line has impedance Zl, and the load is a balanced wye with branch impedance Z. Line to line voltage, $|Vab|$ = 45kV ,$Zl = (0.5 + j3)\Omega$, $Z = (4.5 + j9)\Omega$. Find the line currents, power consumed by the load and line losses. Draw the phasor diagram.

   [Ans. $I_a = 2\angle -67.38° A$, $I_b = 2\angle 172.62° A$, $I_c = 2\angle 52.62° A$, P_{Load} = 53.99 MW, P_{Line} = 6 MW]

2. A balanced 3-phase a-b-c system with line-to-line voltage Vab = $208\angle 0^0$ V supplies to a balanced Δ connected load of 3 kW with a power factor of 0.8 (lag) through a lossless transmission line. Find the line currents. Draw the phasor diagram.

   [Ans. $I_a = 10.41\angle -66.9° A$, $I_b = 10.41\angle 173.1° A$, $I_c = 10.41\angle 53.1° A$]

3. A balanced 3-phase delta connected load of 160 kW, connected to a line voltage of 1100 V,50Hz, takes a leading current of 100 A. Find the circuit constants of the load per phase.

   [Ans. R_{ph} = 16 Ω, C_{ph} = 307.87 μF]

4. Calculate the value of X_C in Fig. 1 such that the combined circuit behaves as a three phase balanced resistive network.

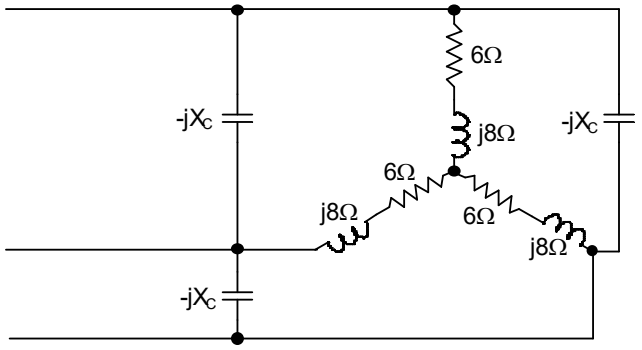

Fig.1

   [Ans. 37.5 Ω]

5. For the 3-phase balanced system of Fig.4 calculate the current phasors $\mathbf{I_{R1}}$ and $\mathbf{I_{R2}}$as marked in the figure with R-phase supply voltage as reference (sequence be RYB). Each Z=$10\angle 30^0$ Ω and each Z_1=$30\angle -90^0$ Ω.

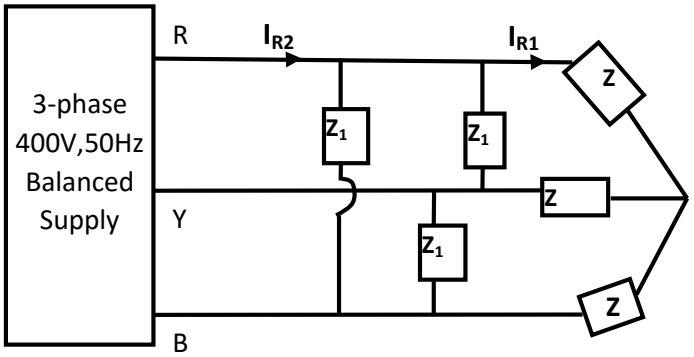

Fig.2

   [Ans. $I_{R_1} = 23.094\angle -30° A$, $I_{R_2} = 23.094\angle 30° A$]

6. For the circuit shown in Fig. 2, calculate the branch currents of the Δ connected load and the active and reactive power consumed by it.

Fig.3

[Ans. $I_{RB} = 5.75\angle -30°\ A$, $I_{BY} = 5.78\angle 30°\ A$, $I_c = 5.78\angle -90°\ A$, P = 499 W, Q = 499 VAR]

7. In the circuit of Fig. 3, A three phase balanced voltage source is supplying power to a three phase constant power load as shown in Fig. 3. Calculate the line currents.

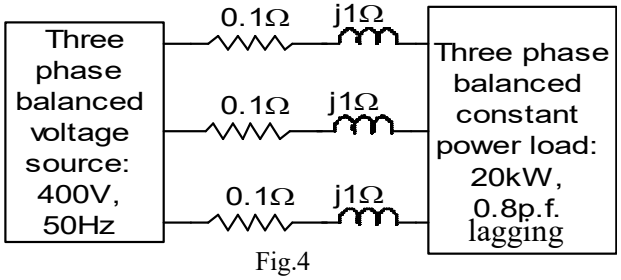

Fig.4

[Ans. $I_a = 41.55\angle -44.86°\ A$, $I_b = 41.55\angle -164.86°\ A$, $I_c = 41.55\angle 75.14°\ A$]

8. A wattmeter reads 5.54 kW when its current coil is connected in R phase and its voltage coil connected between the neutral and the R phase of a symmetrical 3-phase system supplying a balanced load of 30 A at 400 V. What will be the reading on the instrument if the connections to the current coil remain unchanged and the voltage coil be connected between B and Y phases? Take phase sequence RYB. Draw the corresponding phasor diagram.

[Ans. 7.2 kW]

9. Calculate the readings of the two wattmeters (W1 and W2) connected to measure the total power for a balanced delta-connected load fed from a three-phase, 400 V balanced supply with phase sequence as R-Y-B as shown in Fig.5. The load impedance per phase contains capacitive reactance, Xc=14 Ω and resistance, R=14 Ω.

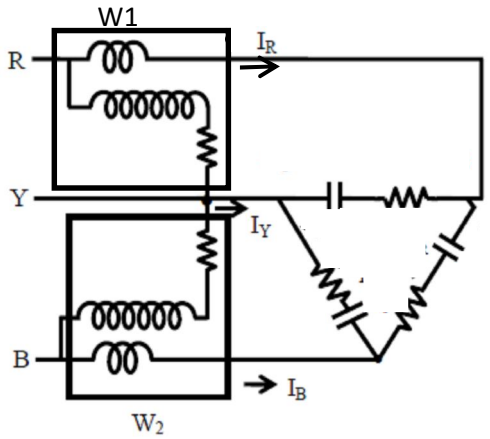

Fig.5

[Ans. W1 = 13.52 kW, W2 = 3.623 kW]