2-1. A wye-wye balanced three-phase system with a phase voltage of 120 V-rms (positive phase sequence) has a line impedance of \( Z_{\text{line}} = (1+j1) \Omega \) and a load impedance of \( Z_Y = (8+j3) \Omega \). If the load voltage for phase \( a \) is 104.02\( \angle 26.6^\circ \) V-rms, determine the source voltages.

**Ans.** \( V_{an} = 120\angle 30^\circ \) V-rms, \( V_{bn} = 120\angle -90^\circ \) V-rms, \( V_{cn} = 120\angle 150^\circ \) V-rms

2-2. A wye-delta balanced three-phase system with a positive phase sequence has negligible line impedance and a load impedance of \( Z_\Delta = (12+j8) \Omega \). If \( I_{AB} = 14.42\angle 86.31^\circ \) A-rms, determine the line currents and the source voltages.

**Ans.** \( I_{aA} = 24.98\angle 56.31^\circ \) A-rms, \( I_{bB} = 24.98\angle -63.69^\circ \) A-rms, \( I_{cC} = 24.98\angle 176.31^\circ \), \( V_{an} = 120\angle 90^\circ \) V-rms, \( V_{bn} = 120\angle -30^\circ \) V-rms, \( V_{cn} = 120\angle -150^\circ \) V-rms

2-3. A wye-wye balanced three-phase system with a line-to-line voltage of 208 V-rms (positive phase sequence) has a negligible line impedance. The total real power dissipated by the load is 12 kW at a PF of 0.8 lagging. Determine \( Z_Y \) (load impedance per phase).

**Ans.** \( Z_Y = 2.88\angle 36.87^\circ \) \( \Omega \)

2-4. A balanced three-phase 120 V-rms wye-connected source (positive phase sequence) supplies a balanced three-phase load. Assume the line impedance is negligible. If the line current \( I_{aA} \) is measured to be 10 A and is in phase with the line-to-line voltage \( V_{BC} \), find the load impedance per phase if the load is (a.) wye-connected (b.) delta-connected.

**Ans.** (a.) \( Z_Y = (0 + j12.0) \Omega \), (b.) \( Z_\Delta = (0 + j36.0) \Omega \)

2-5. A wye-connected balanced three-phase source feeds two balanced three-phase loads that are connected in parallel. The first load absorbs 560.1 kVA at a power factor of 0.707 lagging while the second load absorbs 132 kW at unity power factor. The magnitude of the line-to-line voltage at the load end of the line is 3810.5 V. The line impedance is (0.4 + j2.7) \( \Omega \). Determine (a.) the magnitude of the line-to-line voltage at the source end of the line (b.) the total real and reactive power loss in the line (c.) the real and reactive power delivered by the source.

**Ans.** (a.) \( |V_{AB}| = 4.16 \) kV (b.) \( S_{3\phi,\text{line}} = (12 + j81) \) kVA, (c.) \( S_{3\phi} = (540 + j477) \) kVA
2-6. Two balanced wye-connected loads in parallel, load #1 drawing 15 kW at a power factor of 0.6 lagging and load #2 drawing 10 kVA at a power factor of 0.8 leading, are supplied by a balanced three-phase wye-connected 480 V-rms source. (a.) Draw the power triangle for the individual loads and the combined load. (b.) Determine the power factor for the combined load. (c.) Determine the magnitude of the line current drawn from the source (assume $Z_{line}=0$).

Ans. (a.) $S_1 = 25$ kVA, $Q_1 = 20$ kVAR, $(\theta_v - \theta_i)_1 = 53.13^\circ$, $P_2 = 8$ kW, $Q_2 = -6$ kVAR, $(\theta_v - \theta_i)_2 = 36.87^\circ$, $P_L = 23$ kW, $Q_L = 14$ kVAR, $S_L = 26.93$ kVA, $(\theta_v - \theta_i)_L = 31.33^\circ$
(b.) $PF = 0.854$ lagging (c.) $|I_{aA}| = 18.70$ A-rms.