Tutorial 6

Three-Phase Circuits: Balanced Delta Connected Load

1. A three-phase, three-wire, 110 V system supplies a delta connection of three equal impedances of $5\angle 45^{o}$ Ω. Determine the line currents I_A, I_B and I_C and draw the phasor diagram, taking V_{AB} as the reference.

    Ans: $I_A = 38.1\angle -75^{o}$ A, $I_B = 38.1\angle -195^{o}$ A, $I_C = 38.1\angle 45^{o}$ or $38.1\angle -315^{o}$ A

2. A balanced delta connected load with impedances each of $5\angle -30^{o}$ Ω is connected to a three phase, three wire, 208 V, 50 Hz supply system. Taking V_{BC} as reference, calculate the phase current I_{BC} and the line currents I_A, I_B and I_C in polar form.

    Ans: $I_{BC} = 41.6\angle 30^{o}$ A, $I_B = 72.05\angle 0^{o}$ A, $I_C = 72.05\angle -120^{o}$ A, $I_A = 72.05\angle -240^{o}$ A

3. A three-phase, 3-wire, 220V system supplies a balanced delta connected load with a phase impedance of $10\angle 40°$ Ω. Taking V_{CN} as the reference, determine:
    (a)   the phase current I_{CA} in polar form.
    (b)   the total power consumed.

    Ans: $I_{CA} = 22\angle -10^{o}$ A, $P_T = 11.12$ kW

4. A 220 V, three-phase voltage is applied to a balanced delta-connected three-phase load of phase impedance $(15 + j20)$ Ω. Taking V_{BC} as the reference, determine:
    (a)   the line current I_C, and
    (b)   the power consumption per phase.

   Ans: $I_C = 15.242\angle -203.13^{o}$ A or $15.242\angle 156.87^{o}$ A, $P_{PH} = 1162$ W

5. A star-connected, three-phase load consists of three similar impedances. When the load is connected to a three-phase, 500 V, 50 Hz supply, the line current is 28.85 A and the power factor is 0.8 lagging.
    (a)   Calculate
          (i) the total power taken by the load, and
          (ii) the resistance of each phase of the load.
    (b)   If the phase loads were now re-connected in delta and supplied from the same three-phase system, determine the current flowing in each line.

    Ans: $P_T = 20$ kW, $R_{PH} = 8$ Ω, $I_{L(\Delta)} = 86.6$ A

6. A balanced delta-load with impedances each of $27\angle -25^{o}$ Ω and a balanced Y-load with impedances each of $10\angle -30^{o}$ Ω are both connected to a three-phase, three-wire, 208 V, ABC system. Find the total line currents in phasor form and the power in each load. Take V_{AB} as the reference.

    Ans: $I_A = 25.3\angle -2.62^{o}$A, $I_B = 25.3\angle -122.62^{o}$A , $I_C = 25.3\angle 117.38^{o}$ A or

    $25.3\angle -242.62^{o}$ A, $P_\Delta = 4355.6$ W, $P_Y = 3744$ W
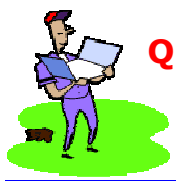
Quiz – 3 questions
(Balanced Delta
Load)