Power Engineering 3

Tutorial 2: 3 Phase Systems

Q1 For a 3 phase system with a phase voltage of 10kV determine the line currents, draw the resultant phasor diagram (to scale) and calculate the total (real) power (W) for a balanced star (wye) connected load of 10 + j20.

Q2 Each phase of a 3 phase delta connected load can be represented by a 50Ω resistor in series with a 60mH inductor. Determine the following for connection to a 440V/50Hz 3 phase supply:

1. Load Phase Currents I_{RY}, I_{YB} and I_{BR}
2. The phasor diagram (to scale) and from this determine the line currents I_R, I_Y and I_B
3. The Apparent Power (VA), Real Power (W) and Reactive Power (VAr) in each phase

(note: if not stated then ALWAYS assume that the given voltage is the LINE voltage V_L)

Q3 A star connected load has a wire connecting the star point to the neutral of a 400V/50Hz 3 phase supply. The load on the red phase is 10, the load on the yellow phase is 7 + j5 and the load on the blue phase is 15 - j3. Calculate the line currents (I_R, I_Y and I_B), sketch the phasor diagram to scale and from this estimate the magnitude of the Star/Neutral current I_{SN}. Suggest a suitable diameter of wire for the Star/Neutral connection.

Q4 The load in Q3 is now delta connected. Calculate the load phase currents and construct a scaled phasor diagram to determine the line currents. Calculate the total load power (W) and from the phasor diagram show that the 2 Wattmeter method correctly predicts (allowing for estimation errors!) the total load power for an unbalanced delta connected load.

Q5 A large single phase load (represented by a resistance of 0.3Ω) is to be connected to a three phase 415V/50Hz system. Determine the necessary (delta connected) Capacitance and Inductance reactances to give balanced conditions. Calculate the resultant load phase currents and from a scaled phasor diagram plot and estimate the three line currents.

Q6 Construct the phasor diagram for a balanced star connected load with lagging currents and prove that the 2 Wattmeter method correctly calculates the total power loss in the 3 phase load. (Note: I did a similar proof for a balanced Delta connected load in Lecture 5).