Tutorial Sheet – No 7

(Balanced Three-phase Systems)

1 A 440V_{rms} three-phase supply is connected to a balanced star connected load. The load phase current is 30A_{rms} and lags 30° behind the phase voltage. Find the phase voltage and the total power to the load.

(254.0V_{rms}; 19.8kW)

2 A 415V_{rms}, 3-phase, 3 wire supply is connected to a balanced star-connected load which draws a line current of 20A_{rms} lagging by 30°. Calculate the total power dissipated in the load and the voltage across each leg of the star.

(12.45kW; 239.6V_{rms})

3 If the load in question 2 is reconnected in delta, what are the new line current, total power and voltage across each leg?

(60A_{rms}; 37.35kW; 415V_{rms})

4 Each phase of a delta connected load consists of a 50Ω resistor in series with a 50μF capacitor. Calculate the line and phase currents and the total load power and volt-amps, when connected to a 440V_{rms}, 50Hz, three-phase supply.

(9.41A_{rms}; 5.43A_{rms}; 4.43kW; 7.17kVA)

5 A three-phase, star-connected generator provides a 2.2kV_{rms} supply for a delta connected induction motor. If the motor is 93% efficient and is operating at 0.85 power factor lagging, calculate the phase currents of the generator and the motor when the motor is delivering 1.49 MW of mechanical power.

(494A_{rms}; 285A_{rms})

6 A balanced, three-phase, star-connected motor has a terminal impedance of (8+j6)Ω per phase and is connected to a 415V_{rms}, 50Hz supply. Calculate its line current, phase power factor and total output power if it is 90% efficient. Power-factor improvement is achieved by placing three 200μF capacitors in star across the motor terminals. Calculate the new line current from the supply.

(24A_{rms}; 0.8 lag; 12.42kW; 19.2A_{rms})

7 Three equal impedances of (7.07 + j7.07)Ω are connected in star across a 220V_{rms} supply. Determine the magnitude and phase angle of each of the phase voltages and line currents, taking the voltage between lines A and B as reference and the phase sequence as ABC. Two wattmeters are connected to measure the total power into the load. If one wattmeter is connected with its current coil in line A and its voltage coil between lines A and B, calculate the reading on this meter. Where would you place the second meter and what would be its reading?

(V_{AN} = 127∠ -30°V_{rms}; V_{BN} = 127∠ -150°V_{rms}; V_{CN} = 127∠ -270°V_{rms};
I_A = 12.7∠ -75°A_{rms}; I_B = 12.7∠ -195°A_{rms}; I_C = 12.7∠ -315°A_{rms};
W_1 = 723W; In line C and between lines C and B, W_2 = 2698W)