

ECE471 INDUSTRIAL POWER SYSTEMS

Assignment # 1

1. A balanced Δ -connected load having an impedance of $24 + j18 \Omega/\text{ph}$ is connected in parallel with a balanced Y-connected load having an impedance, of $20/0 \Omega/\text{ph}$. The paralleled loads are fed from a line having an impedance of $0.1 + j0.5 \Omega/\text{ph}$. The magnitude of the line-to-neutral voltage of the Y-load is 680 V.
 - a) Calculate the magnitude of the current in the line feeding the loads.
 - b) Calculate the magnitude of the phase current in the Δ -connected load.
 - c) Calculate the magnitude of the phase current in the Y-connected load.
 - d) Calculate the magnitude of the voltage at the sending end of the line.

2. The three pieces of computer equipment described below are installed as part of a computer center. Each piece of equipment is a balanced three-phase load rated at 208 V.
 - Disk: 6.157 kVA at 0.79 pf lag.
 - Drum: 16.93 kW at 0.96 pf lag.
 - CPU: line current 73.8 A, 22.694 kW.Calculate:
 - (a) the magnitude of the line current supplying these three devices, and
 - (b) the power factor of the combined load.

3. A three-phase, 5 hp, 208 V, 60 Hz induction motor runs at 1164 rpm when it delivers rated output power.
 - (a) Determine the number of poles of the machine.
 - (b) Determine the slip at full load.
 - (c) Determine the frequency of the rotor current.
 - (d) Determine the speed of the rotor field with respect to the
 - (i) Stator.
 - (ii) Stator rotating field.

4. A three-phase, 460 V, 100 hp, 60 Hz, eight-pole induction machine operates at 3% slip (positive) at full load.
 - (a) Determine the speeds of the motor and its direction relative to the rotating field.
 - (b) Determine the rotor frequency.
 - (c) Determine the speed of the stator field.
 - (d) Determine the speed of the air gap field.
 - (e) Determine the speed of the rotor field relative to:
 - (i) the rotor structure
 - (ii) the stator structure
 - (iii) the stator rotating field.

5. A 40 hp motor has a full-load speed of 1150 rpm. Calculate its full-load torque.

6. Calculate the synchronous speed of a 60 Hz, eight-pole motor in (a) rpm and (b) rad/s.

7. A 60 Hz, six-pole induction motor has a full-load slip of 3.0%. Calculate its rated speed.

8. Calculate the full-load efficiency of a 50 hp, three-phase, 460 V motor that has a rated line current of 65 A at a power factor of 90%. (Use Equation 1.12 for power input.)