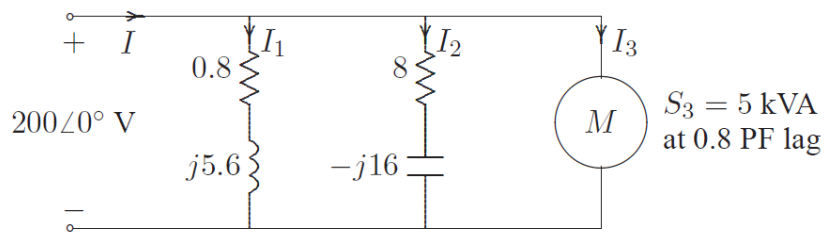1. Two impedances, Z1 = 0.8 + j5.6Ω and Z2 = 8 - j16Ω, and a single-phase motor are connected in parallel across a 200-V rms, 60-Hz supply as shown in Figure. The motor draws 5 kVA at 0.8 power factor lagging.

[30]

(a) Find the complex powers S1, S2 for the two impedances, and S3 for the motor. (10 marks)

(b) Determine the total power taken from the supply, the supply current, and the overall power factor. (10 marks)

(c) A capacitor is connected in parallel with the loads. Find the kvar and the capacitance in μF to improve the overall power factor to unity. What is the new line current **I**? (10 marks)

2. A balanced Δ-connected load consisting of a pure resistance of 18 Ω per phase is in parallel with a purely resistive balanced Y-connected load of 12 Ω per phase as shown in the Figure. The combination is connected to a three-phase balanced supply of 346.41-V rms (line-to-line) via a three-phase line having an inductive reactance of j3Ω per phase. Taking the phase voltage V_{an} as reference, determine.

[20]
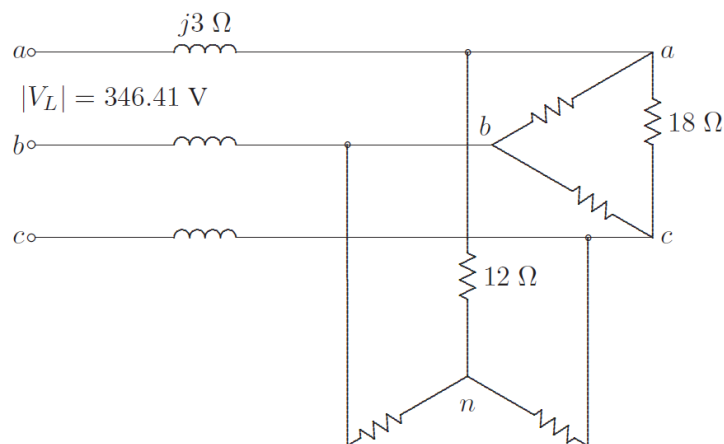
(a) Find the equivalent Y-connected load impendence for the balanced Δ-connected load consisting of a pure resistance of 18 Ω per phase, and plot the phase 'a' equivalent circuit of the system. (5 marks)

(b) The current, real power, and reactive power drawn from the supply. (10 marks)

(c) The line-to-neutral and the line-to-line voltage of phase a at the combined load terminals? (5 marks)

3. **Essay Writing (Within 400 words)**

   Title: The Smart Grid: A Double-Edged Sword?

   Please discuss the potential benefits and challenges of implementing smart grid   [50]
   technologies, and select one of the factors like cybersecurity, privacy, and
   economic impacts to discuss in-depth.