1- Three loads are connected in parallel across a 12.47 kV three-phase supply.
Load 1: Inductive load, 60 kW and 660 kvar. Load 2: Resistive load of 60 kW.
Load 3: Capacitive load, 240 kW at 0.8 power factor. Write Matlab Script File to:

(a) Find the total complex power, power factor, and the supply current.

(b) A Y-connected capacitor bank is connected in parallel with the loads. Find the total kvar and the capacitance per phase in μF to improve the overall power factor to 0.8 lagging?

(c) What is the new line current in part (b)?

2- A 34.64-kV, 60-MVA, three-phase salient-pole synchronous generator has a direct axis reactance of 13.5Ω and a quadrature-axis reactance of 9.333 Ω. The armature resistance is negligible.Write Matlab Script File to Compute the load angle δ and the per phase excitation voltage E when the generator delivers rated MVA, 0.8 power factor lagging to an infinite bus bar of 34.64-kV line-to-line voltage.

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Solution OF MID TERM EXAM

PROB. (1).....

$$j$$

$$\begin{aligned} S_1 &= \ \ 60 \text{ kW} + j660 \text{ kvar} \\ S_2 &= \ \ 60 \text{ kW} + \ \ \ 0 \text{ kvar} \\ S_3 &= 240 \text{ kW} - \ 180 \text{ kvar} \end{aligned}$$

(a) The total complex power is

$$S = 360 \text{ kW} + j480 \text{ kvar} = 600\angle 53.13^\circ \text{ kVA}$$

The phase voltage is

$$V = \frac{12.47}{\sqrt{3}} = 7.2\angle 0^\circ \ \text{kV}$$

The supply current is

$$I = \frac{600\angle -53.13^\circ}{(3)(7.2)} = 27.77\angle -53.13^\circ \ \text{A}$$

The power factor is $\cos 53.13^\circ = 0.6$ lagging.

(b) The net reactive power for 0.8 power factor lagging is

$$Q' = 360 \tan 36.87^\circ = 270 \ \text{kvar}$$

Therefore, the capacitor kvar is $Q_c = 480 - 270 = 210$ kvar, or $S_c = -j210$ kVA.

$$X_c = \frac{|V_L|^2}{S_c^*} = \frac{(12.47 \times 1000)^2}{j210000} = -j740.48 \ \Omega$$

$$C = \frac{10^6}{(2\pi)(60)(740.48)} = 3.58\mu\text{F}$$

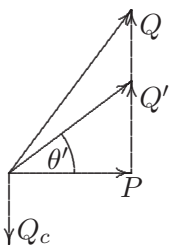

FIGURE 14
The power diagram for Problem 2.15.

$$I = \frac{S^*}{V^*} = \frac{360 - j270}{.} = 20.835\angle -36.87^\circ \ \text{A}$$

Solution OF MID TERM EXAM

Prob. (1) Matlab Program

Solution OF MID TERM EXAM

PROB. (2).....

$$V_\phi = \frac{34.64}{\sqrt{3}} = 20 \text{ kV}$$

For 60 MVA, 0.8 power factor lagging, $S = 60\angle 36.87^\circ$ MVA

$$I_a = \frac{S^*}{3V_\phi^*} = \frac{60000\angle -36.87^\circ}{(3)(20)} = 1000\angle -36.87^\circ \text{ A}$$

$$\delta = \tan^{-1} \frac{(9.333)(1000)(0.8)}{20000 + (9.333)(1000)(0.6)} = 16.26^\circ$$

The magnitude of the no-load generated emf per phase is given by

$$\begin{aligned} |E| &= |V| \cos\delta + X_d |I_a| \sin(\theta + \delta) \\ &= 20 \cos 16.26^\circ + (13.5)(1000)(10^{-3}) \sin 53.13^\circ = 30 \text{ kV} \end{aligned}$$

Prob. (2) Matlab Program