Section: 1:00-2:00 / Dr. Ghazi الاسم: ...

arks) Q(1): Three loads are connected in parallel across 250V (rms) as shown in Fig.1. ad 1 absorbs 16kW and 28 kVA. Load 2 absorbs 10kVA at 0.6 leading PF. Load 3 absorbs 8KW unity PF.

1- Find the Impedance that is equivalent to the three parallel loads.
2- Find the power factor of the total load.
3- If the source operates at 50 Hz, find the value of the capacitor to be connected in order to improve the power factor to 0.96.

Fig. 1

(i)

(1) VI_1 = apparent power

$\frac{28K}{250V} = I_1 = 112$ Arms

P.F. 1 $= \frac{P}{28K} = \frac{16kW}{28kVA} = 0.57 = \cos(\theta - \phi_1) = \cos(-\phi_1)$

Lagging

$\phi_1 = \cos^{-1}(0.57)$

$\phi = -55.15$

$I_1 = 112 \angle -55.15$ Arms

$L_1 = \frac{V}{I_1} = \frac{250\angle 0^\circ}{112\angle -55.15} \Rightarrow L_1 = 1.275 + j1.83\ \Omega$

(ii) $VI_2 = 10k \rightarrow I_2 = \frac{10k}{250} = 40$ Arms

P.F: $\cos(\theta - \phi) = 0.6$

$\phi = \cos^{-1}(0.6)$

$\phi = 53.13$

$I_2 = 40\angle 53.13$ Arms

$L_2 = \frac{V}{I_2} = \frac{250\angle 0^\circ}{40\angle 53.13} \Rightarrow L_2 = 3.75 - j5\ \Omega$

(iii) $I_3 V \cos(0) = 8kW$

$I_3 = 32$ Arms

$L_3 = \frac{250\angle 0^\circ}{32\angle 0^\circ} = 7.8125\ \Omega$

$Z_{eq} = \left(\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}\right)^{-1} = \left(\frac{1}{1.275 + j1.83} + \frac{1}{3.75 - j5} + \frac{1}{7.8125}\right)^{-1}$

$Z_{eq} = 1.666 + 0.832\ \Omega$

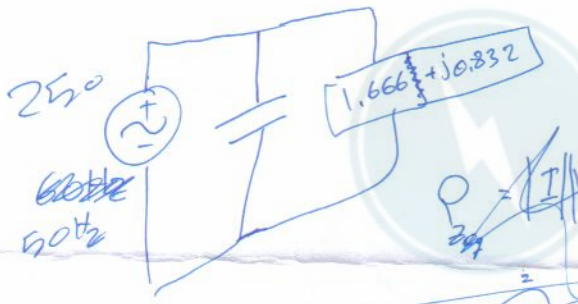
$Z_{eq} = 1.666 + j0.832\ \Omega$

$Z_{eq} = 1.86 \angle 26.538$

$P.F = \cos(26.538) = 0.8946$ lagging

+

$PF = 0.8946$ lagging



$I = \frac{250}{Z_{eq}} = 134.2 \angle -26.538$

$P_A = 250 * 134.2 * 0.8946$

$P = 30.013$ kW

$P = P_{L1} + P_{L2} + P_{L3}$

$= 16$ kW $+ 10$ kVA $* 0.8 + 8$ kW

$= 30$ kW

$C = \frac{P\left(\tan^{-1}\theta_1 + \tan^{-1}\theta_2\right)}{\omega V_{rms}^2} = 1.2$ mf

$C = 1.2$ mf

Section: 1:00-2:00 Dr. Ghazi Sakkar الاسم:

rks) Q(2): Fig.2 shows the instantaneous power $p(t)$ consumed by the load terminals, where erminal voltage is given by $v(t) = V_m \cos(\omega t)$, then find the followings:

1- PF.
2- The reactive power Q.
3- The Complex power $\boldsymbol{S}$.

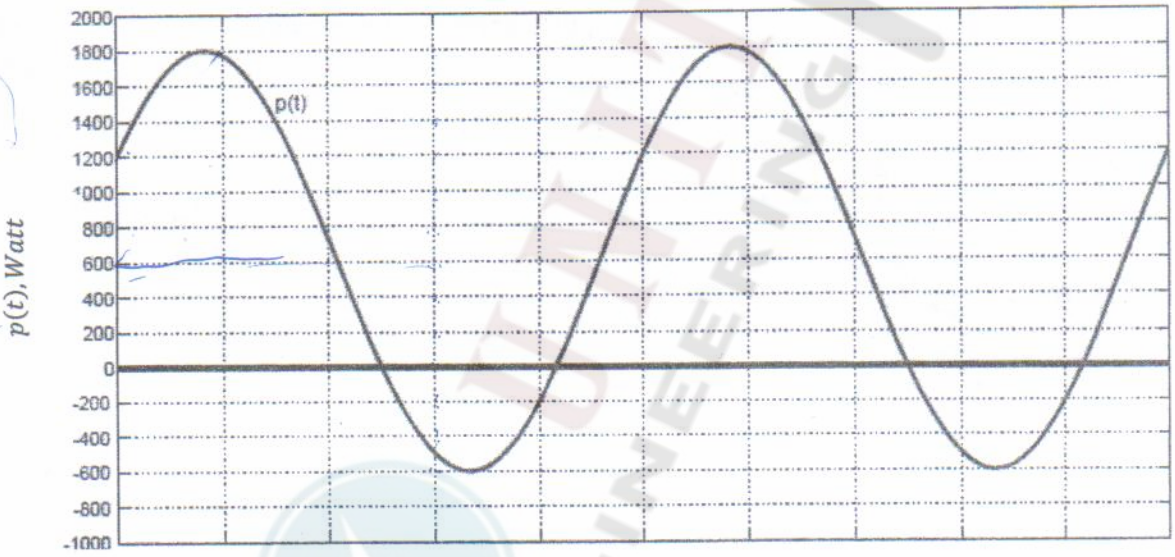


Fig. 2

$P = 600$ watt

Apperak power $= \frac{1800-(-600)}{2} = 1.2$ KVA

$P.f = \frac{P}{A.P} = \frac{600}{1.2k} = 0.5$

Iage V

$\cos(\theta-\phi) = 0.5$

Zero $-\phi = \cos^{-1}(0.5)$

$-\phi = 60$ $\phi = -60$

PF = 0.5 Lagging

Q = Apperant power $\sin(\theta-\phi)$

$= 1.2$ KVA $\sin(0-(-60))$

$= 1.039$ KVAR

$Q = 1.039$ KVAR

$S = 600 + j1039$

$S = P + jQ$

$= 600 + j1039$

$S = 600 + j1039$

Section: 1:00 - 2:00 Dr. Ghazi Sokkar الاسم: ...

marks) Q(3): In the system shown in Fig.3, given $Z_Y = 20 + j8\ \Omega$, and (+) phase sequence is assumed. If $I_{aA} = 20\angle -46°\ A\ rms$, and the source is operating with $PF = 0.94$ lagging, find the following:

1- R_w
2- The total complex power supplied by the source
3- V_{an}.
4- V_{AB}.

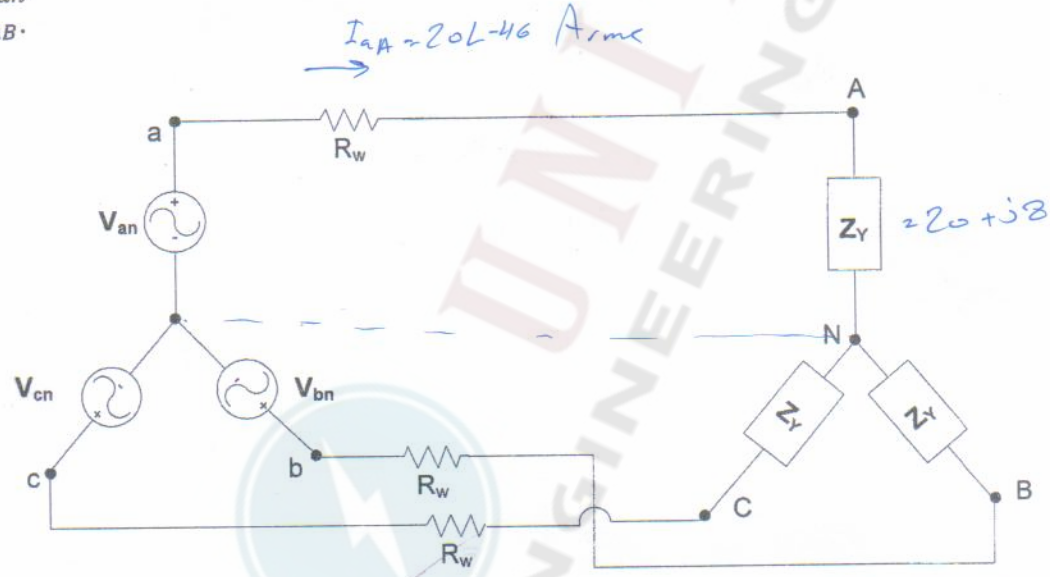
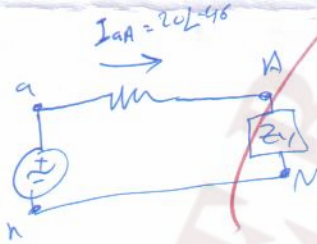


Fig. 3



$\cos^{-1}(0.94) = \theta + 46$

$\theta = -26.05$

$\theta - \phi = 19.95$

$\theta - \phi = \angle Z_Y + R$

$\theta - \phi = \angle Z_Y + R$

$19.95 = \angle Z_Y + R$

$19.95 = \tan^{-1}\frac{8}{20+R}$

$\tan 19.95 = \frac{8}{20+R}$

$0.363 = \frac{8}{20+R}$

$0.363(20+R) = 8$

$7.26 + 0.363R = 8$

$R_w = 2.038\ \Omega$

$R_w =$ 2.038 Ω

Section: 1:00-2:00 Pr. Ghazi

الاسم: ..... مصطفى

$I R = V$

$V = 20\angle -46 * 22.032 + j8$

$V = 468.9\angle -26.05$

V_{an}

$S = P + jQ$

$P = |I||V| \cos(\theta - \phi)$

$= (20 * 468.9) * \cos(0.44)$

$P = 8815.3\ W$

$Q = (20 * 468.9) * \sin(\theta - \phi)$

$= 3199.7\ VAR$

$S = (8.815 + j3.199)\ kW$

$V_{an} = 468.9\angle -26.05$

$V_{an} = 468.9\angle -26.05\ V$

$V_{AN} = I Z_Y$

$= 430.8\angle -24.2$

$V_{AB} = \sqrt{3}\ V_{AN}\angle +30^\circ$

$= 746.2\angle +5.8$

$V_{AB} = 746.2\angle +5.8^\circ\ V$

Good luck

Thank you 6/6 ☺