CIRCUITS 2
FIRST EXAM
FALL-2013

POWER UNIT
ELECTRICAL ENGINEERING

Q1) 11/15
Q2) 8/8
Q3) 17/[illegible]
Q4) 5/25
Q5) 29/35

70/100 = 18/25

University of Jordan

Electrical Eng. Dept

EE 93212 circuit (2) First Exam.

4-11-2013

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Q1) The phasor voltage $V=8\angle 0^0$ V is applied across the impedance $Z=4\angle 60^0$ Ω . If ω=π Rad. /S, draw on the same graph the followings:

a-The instantaneous power p(t) with time t.

b-The voltage v(t) with time t. [15%]

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$v(t) = 8\cos(\pi t)$

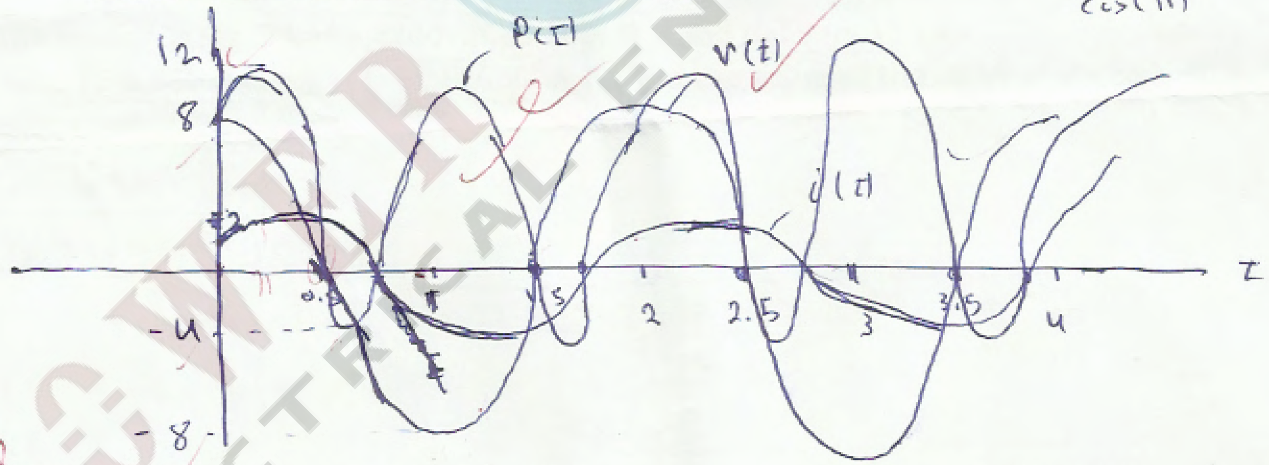
$I = \frac{8\angle 0}{4\angle 60} = 2\angle -60^\circ$

$i(t) = 2\cos(\pi t - 60^\circ)$

$p(t) = v(t)\, i(t)$

$= 8\cos(\pi t) * 2\cos(\pi t - 60^\circ) = 16\left(\frac{1}{2}\cos(60^\circ) + \frac{1}{2}\cos(2\pi t - 60^\circ)\right)$

$p(t) = 4 + 8\cos(2\pi t - 60)$



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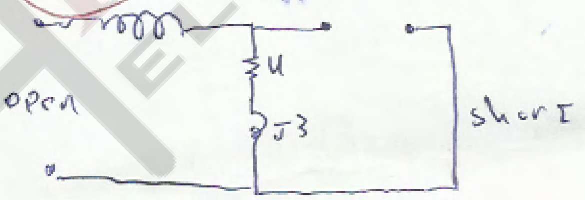
Q2) Evaluate R in Fig.1 to which maximum power is supplied. [8%]



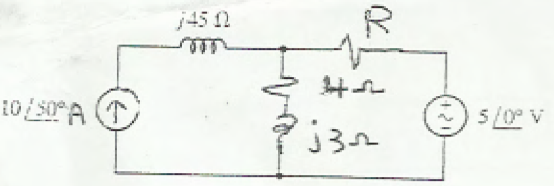


Fig. 1

$Z_{th} = 4 + j3 = R_{th} + jX_{th}$

$R_L = \sqrt{(R_{th})^2 + (X_{th})^2} = \sqrt{(4)^2 + (3)^2} = 5\,\Omega$

$R_L = 5\,\Omega$

Q3) For the signals shown in Fig. 2, calculate the effective value of the voltage v(t), if $v(t)= v_1(t)+ v_2(t)+ v_3(t)$ [17%]

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~~$v_1(t) = 30\cos(\frac{2\pi}{6.667\times10^{-3}}$~~

$v_2(t) = 40\sin(\frac{2\pi}{20\times10^{-3}}t) = 40\cos(\frac{2\pi}{20\times10^{-3}} - 90)$

$v_1(t) = 50\cos(\frac{2\pi}{20\times10^{-3}}t - 36^\circ)$

$V_3(t) = -\sin(\frac{2\pi t}{6.667}t + 54)$

$V_3(t) = \sin(\frac{2\pi t}{6.667\times10^{-3}} + 234)$

$V_3(t) = 30\cos(\frac{2\pi t}{6.667\times10^{-3}} + 144)$

$V_2(t), V_1(t)$ — same freq

$40\angle{-90} + 50\angle{-36} = 80.31899\angle{-60^\circ}$

$V(t) = 80.31899\cos(\frac{2\pi}{20\times10^{-3}}t - 60^\circ) + 30\cos(\frac{2\pi t}{6.667\times10^{-3}} + 144)$

$V_{r.m.s} = \sqrt{\frac{(80.31899)^2}{2} + \frac{30^2}{2}} = 60.626$ r.m.s

$-\sin(\omega t)$

3.3335 — 180

20 — 360
2 — V
6.6667 — 360

18

54

6.6667 — 360°

$-\sin($

$\pi - 36$

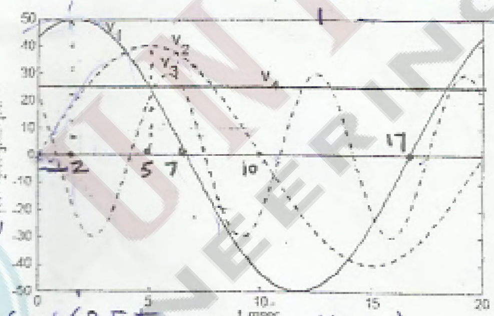
Fig. 2

Q4) The source in Fig. 3 has $v_s=240\sqrt{2}\cos(100\pi t)$ V and delivers 12 kVA with PF 0.866 lagging. If $I_L=50\sqrt{3}\angle{-60^\circ}$ A_{rms}, find the value of the capacitor. [25%]

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$\bar{S} = 12KVA\angle{30^\circ}$

$V_s = 240\angle{0}$ r.m.s

$P = 12KVA \times \cos(30) = 10.3923K\omega$

$V_R = J0.6\times 50\sqrt{3}\angle{-60^\circ}$

$V_R = 51.961524\angle{30^\circ}$

$V_L = 240\angle{0} - 51.9615\angle{30^\circ} = 196.723\angle{-7.589}$

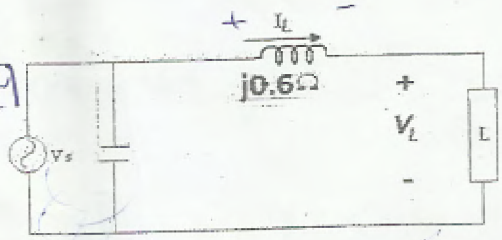


Fig. 3

$Z_L = \frac{V_L}{I_L} = \frac{196.723\angle{-7.589}}{50\sqrt{3}\angle{-60}} = 2.27156\angle{52.411} = 1.3856 + J1.8$

~~$Z_{eq} = (1.3856 + J1.8 + J0.6) \times -\frac{1}{J\omega C}$~~

$Y_L = \frac{1}{Z_L + J0.6} = \frac{1}{1.3856 + J1.8 + J0.6} = 0.18042 - J0.3125$

$Y_C = J\omega C$

$Y_{eq} = J\omega C + 0.18042 - J0.3125 = 0.18042 + J(\omega C - 0.3125)$

$\cos^{-1}(0.866) = 30$

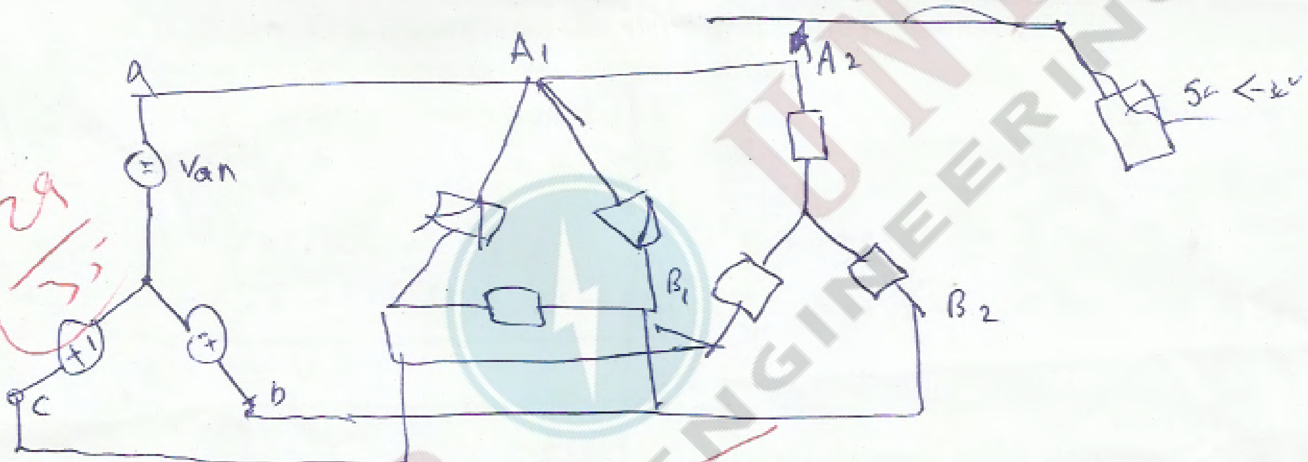
$\tan(30) = 0.57735 = \frac{\omega C - 0.3125}{0.18043}$ $C = 1.326\times10^{-3}$ F

Q5) A balanced Δ-load is connected in parallel with a balanced Y-load. The impedance per phase for Δ is $50\angle -30^0\ \Omega$ and for Y is $25\angle 60^0\ \Omega$.

If $V_{ac}=200\angle 0^0\ V_{RMS}$ and assuming positive phase sequence, find:

a-The current I_{Bb}.

b-The reading of the wattmeter connected in phase C with its potential coil connected between C and N of the Y-load. [35%]



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$V_{ac} = 200\angle 0 \rightarrow V_{ca} = 200\angle 180$

$V_{ab} = 200\angle 420$

$V_{bc} = 200\angle 300$

$V_{ca} = 200\angle 180$

$V_{bc} = \sqrt{3}\, V_{bn}\angle 30$

$V_{bn} = \frac{V_{bc}}{\sqrt{3}\angle 30} = \frac{200\angle 300}{\sqrt{3}\angle 30} = 115.47\angle 270$

a) $I_{B_2n} = \frac{V_{bn}}{Z_\phi}$

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$I_{B_2N} = \frac{V_{bn}}{Z_Y} = \frac{115.47\angle 270}{25\angle 60} = 4.6188\angle -150°$

$I_{B_1C_1} = \frac{V_{bc}}{Z_\Delta} = \frac{200\angle 300}{50\angle -30°} = 4\angle 330°$

$I_{B_1} = \sqrt{3}\, I_{B_1C_1}\angle -30 = 6.928\angle 300°$

$I_{Bb} = I_{B_1} + I_{B_2N} = 6.928\angle 300° + 4.6188\angle -150°$

$I_{Bb} = 8.3211\angle -93.7°$ $I_{Bb} = -I_{bB}$

11/15 b)

اكمل خلف الصفحة

$P = |I_{cc}|\,|V_{cn}|\cos(\angle V_{cn} - \angle I_{cc})$

$I_{cc} = I_{cN} = I_{c_2N} = 4.6188\angle -150-120 = 4.6188\angle -270°$

$V_{cN} = 115.47\angle 270+120 = 115.47\angle 30°$

$W = |I_{cc}| \times |V_{CN}| \cos(\angle V_{CN} - \angle I_{cc})$

$= 4.6188 \times 115.47 \cos(150 - (-270))$ = ~~266.664 W~~

$W = 4.6188 \times 115.47 \cos(150 + 270) =$ **266.666 W**