University of Jordan Department of Electrical Engineering	EE212 - Electric Circuits II Second Semester 2015-2016	First Exam Time: 1 Hour	Thursday, 6/3/2016 15:00 - 16:00 pm

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Section 1
Dr. Mohammed Abuelhaj

Section 3
Dr. Eyad Feilat

Section 4
Mohammed Abuelhaj

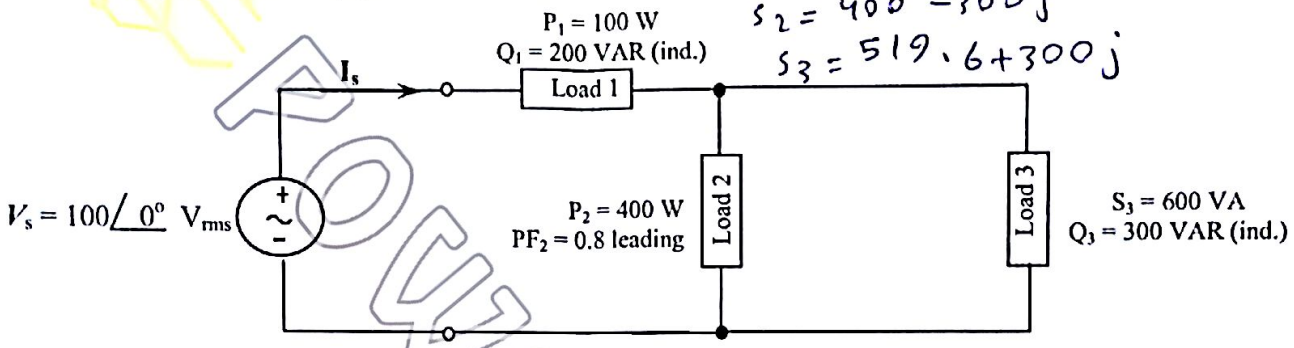
13.5

Questions 1 (5 points)

The circuit shown below consists of three loads in a series-parallel connection, with each of the loads defined as indicated. Find:

a) The overall real, reactive and complex power supplied by the source, P_s, Q_s and S_s.
b) The overall source power factor, PF_s.
c) The source phasor current, I_s.

$S_1 = 100 + 200j$
$S_2 = 400 - 300j$
$S_3 = 519.6 + 300j$



P_s	Q_s	S_s	PF_s	I_s
1019.6	200 VAR	1019.6 + 200j VA	0.9813	$I_S = 10.4\angle -11.1$ A_{rms}

5

$S_1 = 1019.6 + 200j$

$|S| = 1039$

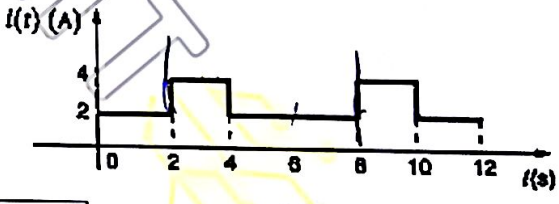
$S = V_{rms} I_{rms}^*$

$I_{rms}^* = \frac{S}{V_{rms}} = 10.4\angle -11.1$

Question 2 (3 points)

The current waveform shown below is flowing through a 4-Ω resistor. Compute

a. the frequency of the signal, f.
b. the effective values (rms) current I_{rms},
c. average power delivered to the resistor, P_{avg}.



f	I_{rms}	P_{avg}
$\frac{1}{6}$ Hz	2.82	32

3

$i(t) = \begin{cases} 4, & 2 < t < 4 \\ 2, & 4 < t < 8 \end{cases}$

$I_{rms}^2 = \frac{1}{T}\left(\int_2^4 16\,dt + \int_4^8 4\,dt\right)$

$= \frac{1}{6}(16(2) + 4 \times 4)$

$= \frac{1}{6}(32 + 16)$

$P_{avg} = |I_{rms}|^2 R$

$T = 6$

$f = \frac{1}{6}$

$T = 6$

Questions 3 (3 points)

A load with 0.8 lagging PF absorbs 60 W from a 100 V, 60 Hz power line. It is required to correct the power factor to 0.9 lagging. Find:

a) The old and new line current,
b) The value of the element (R, L, or C) to be added to achieve the required PF correction.

I_{old}	I_{new}	Value of the element
$1.06\angle -36.86$	$0.942\angle -25.8$	$C = 8.449\ \mu F$

1

$pf_1 = 0.8 \quad \theta_1 = 36.86$

$S_1 = 60 + 45j$

$V = 100V$

$f = 60Hz$

$pf_2 = 0.9 \quad \theta_2 = 25.84$

$S_2 = 60 + 29j$

$S = \frac{1}{2} V_{Rms} I^*_{Rms}$

$I^*_{Rms} = \frac{60+45j}{100/\sqrt{2}} = 1.06\angle 36.86$

$I_{Rms} = 1.06\angle -36.86$

$C = \frac{P(\tan\theta_1 - \tan\theta_2)}{\omega V^2_{Rms}} = \frac{60(\tan(36.86) - \tan(25.84))}{2\pi 60 \cdot (\frac{100}{\sqrt{2}})^2}$

Questions 4 (3 points)

The 60-Hz line current of a 3-phase balanced, *abc* sequence Y-Y system is 2 A_{rms}. Each phase impedance Z consists of a 30-Ω resistance connected in series with a 106-mH inductance. Find:

a) The magnitudes of phase and line voltages of the load, $|V_{ph}|$ and $|V_{LL}|$.
b) The total real, reactive, and apparent power absorbed by 3-phase load, P_L, Q_L and S_L.
c) The power factor of the load, *PF*.

$\lvert V_{ph}\rvert$	$\lvert V_{LL}\rvert$	P_L	Q_L	$\lvert S_L\rvert$	PF
100	$\sqrt{3}\,100$	200w	266.667	333.33	0.6
	173.2	w	VAR	VA	

1.5

$f = 60$ $\quad I_L = 2A_{rms}$

$Z_Y = 30\Omega + 40j = 50\angle 53.13$

$|V_{ph}| = I_L Z_Y$ $\quad pf =$

$P_L = |I_L|^2 Z_Y$

$=$

106mH

$j\omega L =$

$j\,2\pi \times 60 \times 106 \times 10^{-3}$

$= 39.96\,j$

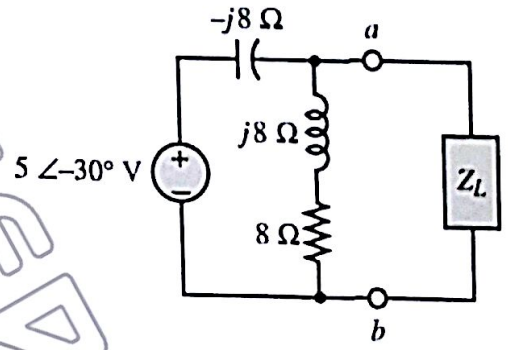
$\approx 40\,j$

Question 5 (3 points)

3

For the circuit shown below

a.	Find, draw and label the Thevenin equivalent circuit as seen from terminals *a-b*.	$V_{th} = 7.07 \angle 15$ $Z_{th} = 8 - 8j$
b.	If the load impedance $Z_L = 3 + j4\ \Omega$, find the load current, I_L.	$I_L = 0.604 \angle 34.9$
c.	If Z_L is adjusted till maximum power is transferred, find Z_L which absorbs maximum power, and find the value of the maximum power, P_{max}.	$Z_L = 8 + 8j$ $P_{max} = \frac{\lvert V_{th}\rvert^2}{8R_{th}} = 0.781$



$$Z_{th} = -j8 \parallel (8+j8)$$

$$Z_{th} = \frac{-8j(8+8j)}{8}$$

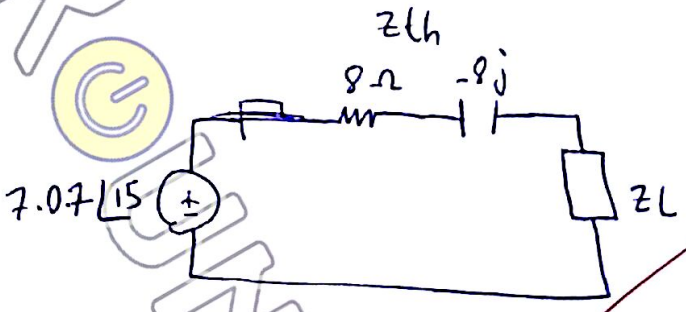
$$Z_{th} = 8 - 8j$$

$$V_{th} = 5\angle -30° \left(\frac{8+8j}{8}\right)$$

$$= 7.07 \angle 15$$

$$Z_L = 3 + 4j$$

$$I_L = \frac{V_{th}}{Z_L + Z_{th}} = \frac{7.07\angle 15}{3+4j+8-8j} =$$



Questions 6 (3 points)

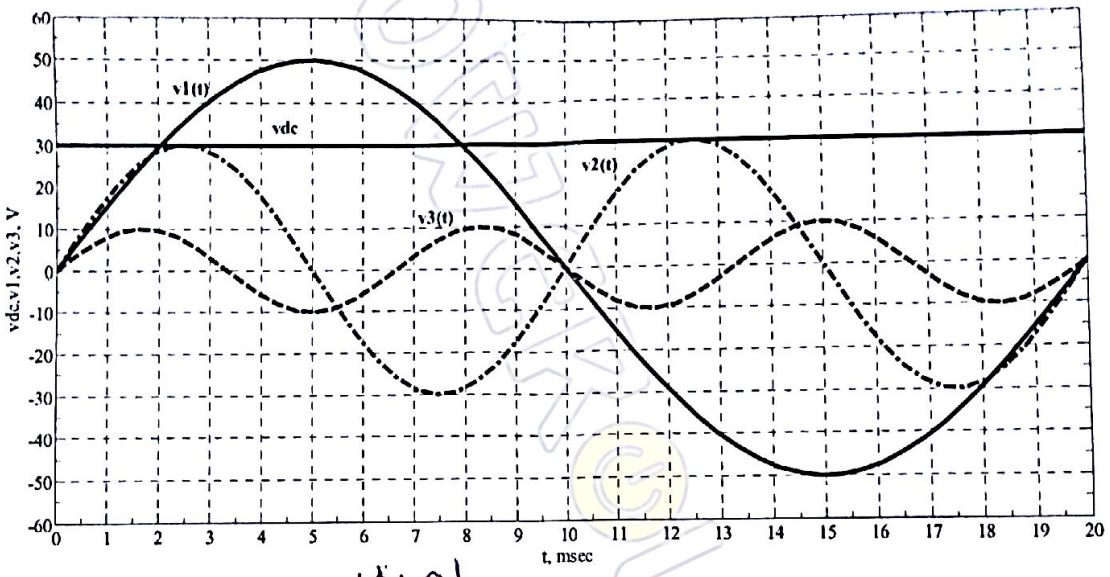
In the Figure shown below, $v(t) = v_{dc}(t) + v_1(t) + v_2(t) + v_3(t)$. Answer questions 6.1-6.3.

6.1 the average voltage V_{dc} is 0 V.

6.2 the effective voltage V_{eff} is 71.83 V.

$P_{avg} = \frac{|V_{eff}|^2}{R}$

6.3 if $v(t)$ appears across a 10-Ω resistor, the average power dissipated is 515.95 W.



$v_{dc}(t)$ $V_1(t) = 50\sin(\omega t + \theta)$

$V_2(t) = 30\sin(\omega t + \theta)$

$V_3(t) = 10\sin(\omega t + \theta)$

$$V_{eff}^2 = \sqrt{\frac{2500}{2} + \frac{900}{2} + \frac{100}{2}}$$

$$V_{eff} = 41.83 + V_{dc} = 41.83 + 30 = 71.83$$

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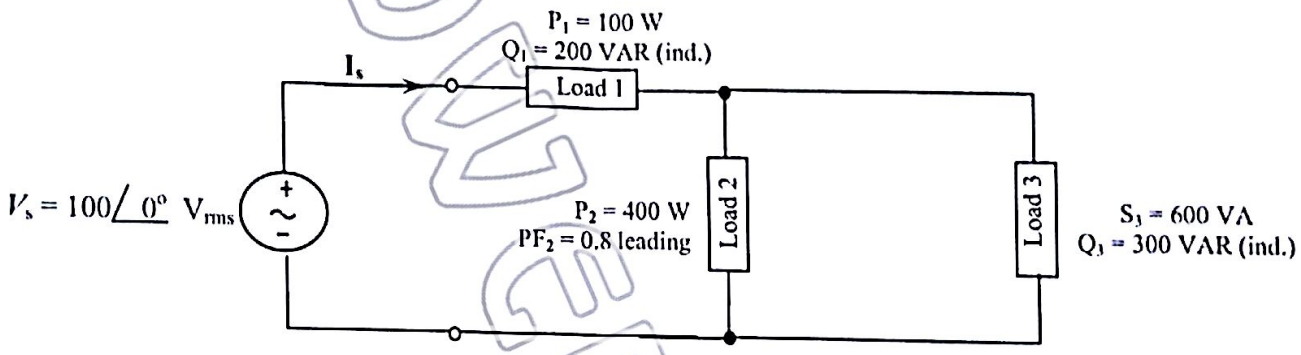

P_s	Q_s	S_s	PF_s	I_s
1019.6 W	**200 VAR**	**1019.6+j200** $S_s = 1039\angle 11.1°$ VA	**0.981** **lagging**	$I_s = 10.39\angle -11.1°$ A

Question 2 (3 points)

The current waveform shown below is flowing through a 4-Ω resistor. Compute

a. the frequency of the signal, f.
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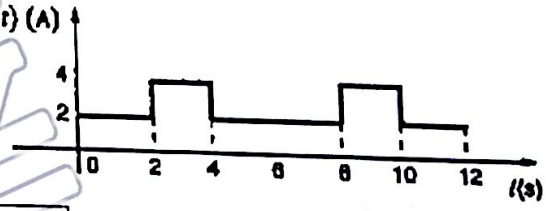

f	I_{rms}	P_{avg}
1/6 Hz	$\sqrt{8}\ A_{rms}$	**32 W**

Questions 3 (3 points)

A load with 0.8 lagging PF absorbs 60 W from a 100 V (peak), 60 Hz power line. It is required to correct the power factor to 0.9 lagging. Find:

a) The old and new line current,
b) The value of the element (R, L, or C) to be added to achieve the required PF correction.

I_{old}	I_{new}	*Value of the element*
$I_{old} = 1.5\angle -36.9°$ A	$I_{new} = 1.33\angle -25.8°$ A	**C=** 8.512×10^{-06} F **8.512 μF**