Q2/B | Q4 | 1. Diagram 2. pf. → 5

UNIVERSITY OF JORDAN

DEPARTMENT OF ELECTRICAL ENGINEERING

ELECTRIC CIRCUITS (0903212)

SECOND EXAM 30MARKS 08/12/2014

17.5/32

NAME: ____ 013 ...

Please write in arabic, your name, ID#, and Seat#/section

7.5/9

Part A

10.5/16

Problem1 [9 marks]: The circuit shown below is energized by a voltage source with $v(t) = 200\sqrt{2}\cos(100\pi t)V$.

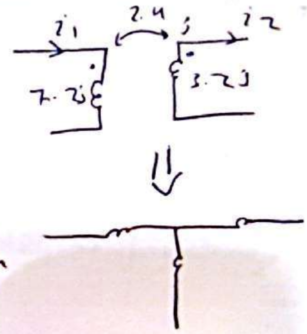
$w = 100\pi$

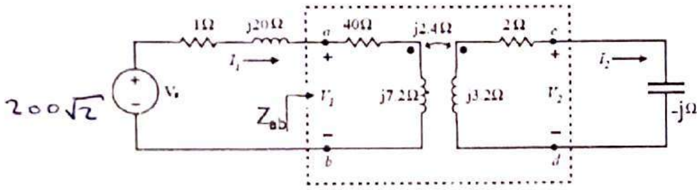
a) Find the impedance seen from terminals $a\&b$ (Z_{ab}).

b) Find I_1, V_1, V_2 and I_2

c) If the reactance of $-j\Omega$ is replaced with an adjustable resistance R_L to maximize the power transfer, find the value of the resistance R_L.

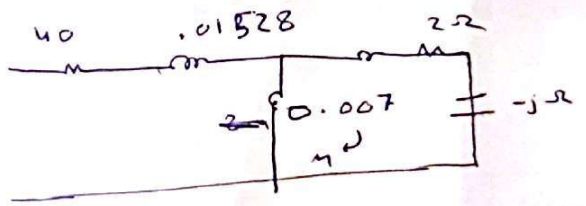
d) Find the energy stored in the magnetic coupled circuit at $t = 12ms$.





L₂ - M

L₁ - M



① $Z_{ab} \Rightarrow$

72 L di₁ ... M di₂ ... M di₁

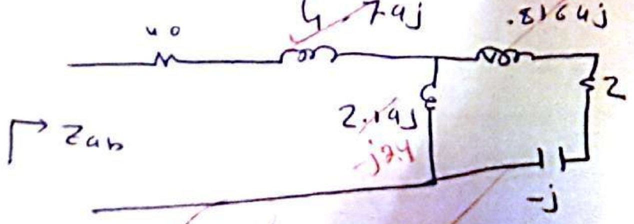
- M di₂ - di₁

$L_1 = ~~2.3~~ \quad .02292\ H.$

$L_2 = .0102\ H.$

$m = 7.6433 \times 10^{-3}\ H.$

$.007643\ H.$



$Z_{ab} = 41.6 \angle ~~7.94~~\ 8.15$ → including (−jΩ)

$I_1 = 5.72 \angle -31.4\ A$

$2I_2 - jI_2 + 3.2jI_2 - 2.4jI_1 = 0$

$I_2 = 2.95 \angle ~~123.1~~ \quad 4.6 \angle 10.87$

$V_1 = 40I_1 + 7.2jI_1 - 2.4jI_2$

$= 238.51 \angle ~~14.8~~ \ -23.4 \quad -79.13$

$V_2 = -jI_2 \Rightarrow ~~2.95~~\ 4.6 \angle ~~...~~$

② $Z_{ab} = 1 + 20j$

لف الصفحة

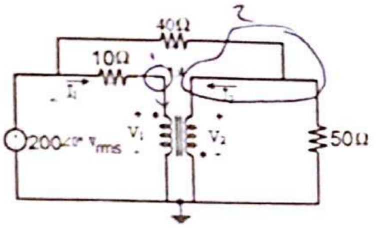
NAME: 8 ... 0132865 ...

Please write in arabic, your name, ID#, and $\frac{Seat\#}{section}$

Problem2 [7 marks]: For the circuit shown below,

a) Find I_1, V_1, V_2 and I_2

b) Find the power dissipated in the 40Ω resister.



3/7

$\frac{V_1 - 200}{10} + I_1 = 0$ — ①

$\frac{V_2 - 200}{40} + I_2 + \frac{V_2}{50} = 0$ — ②

$I_2 = \frac{1}{4} I_1$ — ③

$V_2 = -4V_1$ — ④

$\frac{V_1}{10} - \frac{200}{10} + I_1 = 0 \Rightarrow$ $V_1 + 10 I_1 = 200$ — ①

$\frac{-4V_1}{40} - \frac{200}{40} + \frac{1}{4} I_1 + \frac{-4V_1}{50} = 0$

$\frac{-V_1}{10} + \frac{1}{4} I_1 - \frac{4}{50} V_1 = 5 \Rightarrow$ $V_1\left(\frac{-1}{10} - \frac{4}{50}\right) + \frac{1}{4} I_1 = 5$ — ②

$$\begin{bmatrix} \frac{-1}{10} - \frac{4}{50} \ (-.18) & -\frac{1}{4} \\ 1 & 10 \end{bmatrix} = \begin{bmatrix} 5 \\ 200 \end{bmatrix}$$

$D = (-.18 \times 10) - \frac{1}{4} = -1.55$

$D_x = 2000 - \frac{5}{4} = 1998.75$ ~~1408.75~~ 2100

$V_1 = -64.5$ V

$D_y = -200.9 \Rightarrow I_1 = 98$ Amp

$V_1 = -64.5$ V $\quad I_1 = 26.45$ A

$V_2 = 258$ V $\quad I_2 = 6.61$

(b) $\frac{(V_2 - 200)^2}{40} = 84.1$ w.

P_{40}

NAME: 0137660S [illegible]

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Part B

4

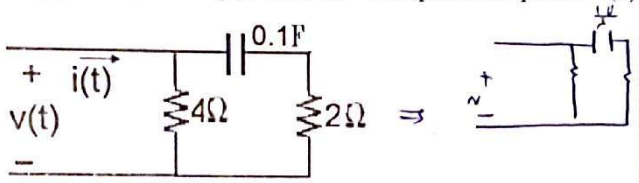
Problem3 [8 marks]: For the circuit shown below:

a) Find $Z(s) = \frac{V(s)}{I(s)}$ for the circuit shown.

b) Find the poles and zeros of $Z(s)$.

c) Sketch $|Z_{in}(s)|$ versus s, if $s = \sigma + j0$.

d) If $v(t) = 25e^{-2t}\ u(t)$, find the complete response $i(t)$, $t \geq 0$.



ⓐ $\left(\frac{10}{s} + 2\right) // 4$

$\Rightarrow \frac{10 + 2s}{s} // 4$

$\dfrac{\frac{40 + 8s}{s}}{\frac{10 + 2s + 4s}{s}} = \frac{40 + 8s}{10 + 6s}$

$\Rightarrow \boxed{\frac{20 + 4s}{5 + 3s}} = Z(s)$

$V(s) = I(s) * Z(s)$

ⓐ $\boxed{Z(s) = H(s) = \frac{V(s)}{I(s)}}$

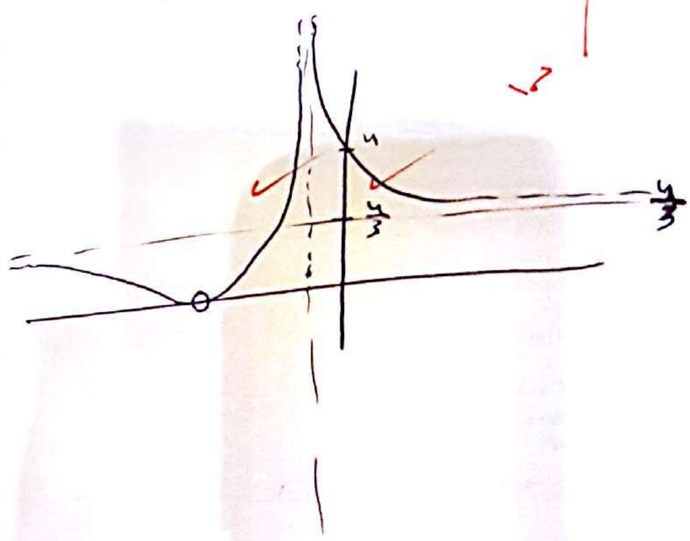
ⓑ $Z(s) = \frac{20 + 4s}{5 + 3s}$

Z(s) have Zeros @ $-5 = s$

Z(s) have poles @ $s = \frac{-5}{3}$

ⓑ Zero $= -5$ ✓ pole $= \frac{-5}{3}$

ⓒ $Z(s) = \frac{20 + 4s}{5 + 3s}$



ⓓ $v(t) = 25e^{-2t}\ u(t)$ $\boxed{s = -2}$

$I(s) = \frac{V(s)}{Z(s)} \Rightarrow I_{nat.} + I_{forc.}$

$I_{forc.} \Rightarrow H(-2) \cdot N$

$\Rightarrow \boxed{-12 + 25e^{-2t}}$

$I_{nat.} = Ae^{\frac{-5}{3}t}$

~~$I(0) = \frac{25}{4}$~~ $A = \frac{25}{4}$

$= 6.25$

$I = 6.25e^{\frac{-5}{3}t} + -12 + 25e^{-2t}$

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3

Problem 4) [8 marks]: The balanced load in the figure shown below is fed from a balanced three-phase system having $V_{ba} = 230\angle 30^0 V_{rms}$ and positive phase sequence. Draw the phasor diagram, then find:

a) the reading of each wattmeter W_1 and W_2.

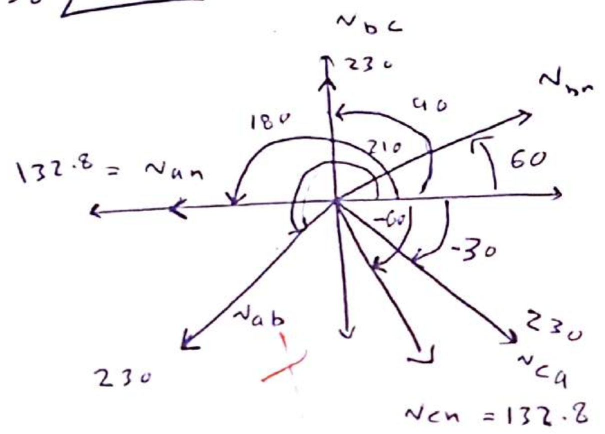
b) the total active and reactive power drawn by the load in terms of the wattmeters readings.

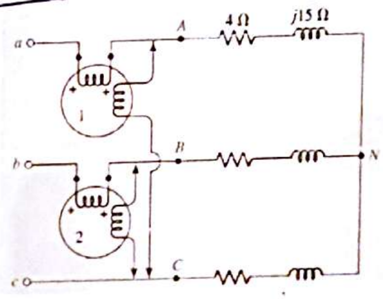
c) the power factor in terms of wattmeters readings.

الصفحة المقابلة

$V_{an} = 132.8\angle 180$

$V_{ab} = 230\angle 210$





$V_{ab} = 230\angle 210$ | $V_{an} = 132.8\angle 180$

$V_{bc} = 230\angle 90$ | $V_{bn} = 132.8\angle 60$

$V_{ca} = 230\angle -30$ | $V_{cn} = 132.8\angle -60$

a) w_1:

$P_A = I_{aA} \cdot V_{AC} \cos(\theta_v - \theta_i)$

$V_{AC} = 230\angle 150 \Leftarrow -V_{CA}$

$I_{aA} = \frac{V_{an}}{4+15j} \Rightarrow \frac{132.8\angle 180}{4+15j}$

$= 8.5\angle 104.9$

So $P_A = W_1 = 8.5 \cdot 230 \cos(150-104)$

$= 1382.4$ w

w_2: $P_B = I_{bB} V_{BC} \cos(\theta_v - \theta_i)$

$V_{BC} = 230\angle 90$

$I_{bB} = \frac{132.8\angle 60}{4+15j} = 8.5\angle -15$

$P_B = W_2 = 8.5 \cdot 230 \cdot \cos(105)$

$= -505.9$ w

الصفحة المقابلة ⇐

b) ~~$S_A = V_{AN} \cdot I_{AN}^*$~~

~~$132.8\angle 180 \cdot (8.5\angle 104.9)^*$~~

~~$S_A = 1128.8\angle 75$~~

~~$= 292.15 + 1090.3j$~~

~~$S_{Load} = 3386.4\angle 75$~~

~~$= 876.5 + 3271j$~~

~~P~~ ~~Q (reactive)~~

c) ~~$PF = \cos(75)$ lag~~

~~$= .2588$ lag.~~

الصفحة المقابلة

$Z_{ab} = (\not{4+20j}^{40} + 7.2j) + \frac{(100 \cdot 314 \cdot .007)^2}{3.2j + 2 + R}$

$Z_{ab} = \frac{(\not{4+20j}^{40} + 7.2j)(3.2j + 2 + R) + (100 \cdot 3.14 \cdot .007)^2}{3.2j + 2 + R}$

$Z_{ab} = \frac{(40 + 7.2j)(3.2j + 2 + R) + (314 \cdot .007)^2}{3.2j + 2 + R}$

$Z_{ab} = \frac{4.83 + 153.4\angle 68 + 406\angle 10 \, R}{(2 + 3.2j) + R}$

$Z_{ab} = (1 + 20j)^*$

R should make $Z_{ab} = 1 - 20j$ ⇒ $R = 2.05\Omega$

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d) $i_1 = 5.72 \cos(100\pi t - 31.4)$

$i_2 = 4.6 \cos(100\pi t + 10.87)$

$L_1 = .02$ $L_2 = .01$ $M = .007$

$E = \frac{1}{2} \cdot .02 \cdot [5.72 \cos(314 \cdot .012 - 31.4)]^2$

$+ \frac{1}{2} \cdot .01 \cdot [4.6 \cos(314 \cdot .012 + 10.87)]^2$

$\mp .007 \cdot 5.72 \cdot 4.6 \cdot \cos(314 \cdot .012 + 10.87) \cos(314 \cdot .012 - 31.4)$

$\Rightarrow .513 \, J$

$-\frac{1}{2}$ (+2.5)

$(1 - 20j)(2 + 3.2j)R = 155.3\angle 66.3 + (406\angle 10)R$

$R = 155.3\angle 66.3 \,/\, [(1-20j)(2+3.2j)]$

③ $\vec{S}_A = V_{AC} \cdot I_{aA}^* \Rightarrow 230\angle 150 \cdot 8.5\angle -104.9$

$1955\angle 45$

$\vec{S}_B = V_{BC} \cdot I_{bB}^* \Rightarrow 230\angle 90 \cdot 8.5\angle 15 \Rightarrow 1955\angle 105$

$\vec{S}_{tot} = 3386.159\angle 75$

④ $\cos(75)$ lag. $\Rightarrow .2588$ lag.

in terms of W-reading