CIRCUITS 2
SECOND EXAM
FALL-2013

POWER UNIT
ELECTRICAL ENGINEERING

22/25

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Q4	0/5
Q5	0/5
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University of Jordan

Electrical Eng. Dept

EE 93212 circuit (2) **Second Exam.**

16-12-2013

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Q1) Evaluate the energy stored in the circuit shown in Fig.1 at t=2 mS given that $i_1=0$, $i_2=5\cos(1000t+30^0)$, k=0.5 and L_1=2 H. **[10 %]**

$K = \frac{M}{\sqrt{L_1L_2}} = \frac{2}{\sqrt{2\times L_2}} = 0.5$ $4 = \sqrt{2L_2}$

$L_2 = \frac{16}{2} = 8\ H$ $L_2 = 8\ H$

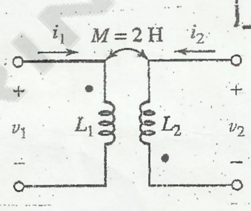

Fig. 1

$w = \frac{1}{2} L_2 I_2^2$

$i_2 = 5\cos(1000t+30)$ @ $t = 2\times10^{-3}$

$i_2(2\times10^{-3}) = 5\cos(2+30) = 5\times -0.815 = -4.0752$

$w = \frac{1}{2}\times(8)\times(-4.075)^2 = 66.4341\ J$

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Q2) Write the mesh equation in frquency domain for the mesh of I_3 in the circuit shown in Fig. 2. **[5%]**

$(11+J6\omega)I_3 - J6\omega I_2 - 6I_1 + J2\omega I_2 = 0$

$(11+J6\omega)I_3 - J4\omega I_2 - 6I_1 = 0$

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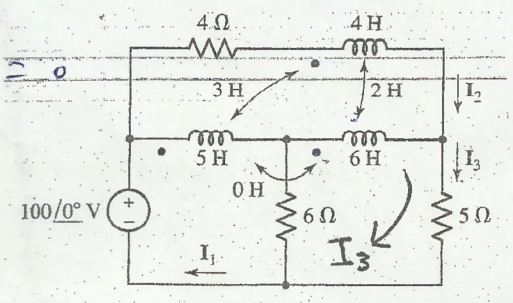

Fig. 2

Q3) Evaluate Z_{in} of the circuit shown in Fig.3, if Z_L is 100 μF having impedance of –j31.38 Ω. **[10 %]**

M = 25 mH

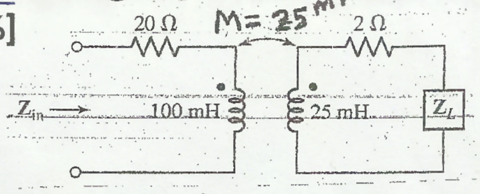

Fig. 3

$Z_L = -J31.38 = \frac{1}{J\omega\times100\times10^{-6}}$

$\omega = \frac{1}{-J31.38\times J100\times10^{-6}} = 318.67$

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$Z_{in} = Z_{11} + \frac{\omega^2 M^2}{Z_{22}}$

$Z_{11} = 20 + J31.867$

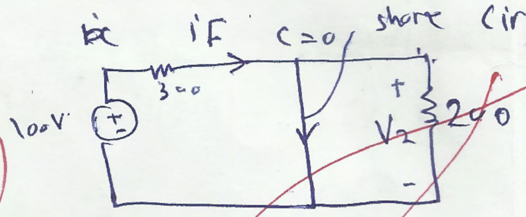
$Z_{22} = 2 - J31.38 + J8 = 2 - J23.41$

$Z_{in} = 20 + J31.867 + \frac{(25\times10^{-3})^2\times(318.67)^2}{2 - J23.41} = 20.23 + J34.56$

Q4) In the circuit shown in Fig.4, if c=0 evaluate V_2. [5 %]

$\frac{Z}{8} = \left(\frac{5}{1}\right)^2$

if c=0, short circuit



$V_2 = \text{Zero}$

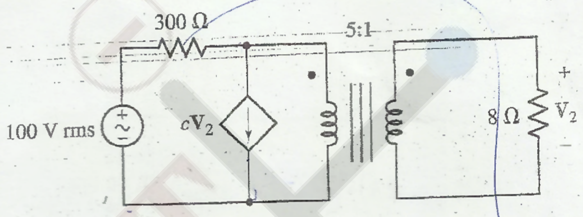
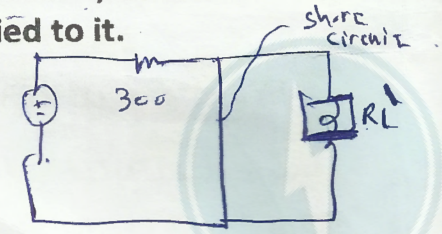


Fig. 4

Q5) In the circuit shown in Fig. 4, if c=0 and the 8 Ω is replaced by a resistance R, evaluate R to which maximum average power is supplied to it. [5 %]

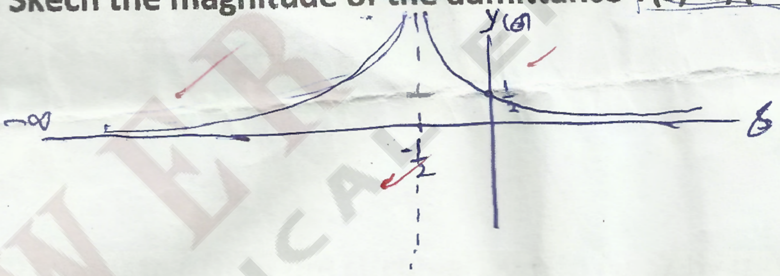


$R_L' = 5^2 R$

$R = \text{Zero}$

No currunt pass through

Q6) Skech the magnitude of the admittance Y(s)=1/(2+4s) with s if s=σ+j0. [5 %]



Q7) The input admittance Y(s) of a given a two terminal network is given as $Y(s)=(s^2+6s+8)/(15s^2+45s)$, evaluate the complete response of the input voltage v(t) if the input current is $i(t)=150\,e^{-t}$. [15 %]

$Y(s) = \frac{s^2+6s+8}{15s^2+45s} = \frac{I(s)}{V(s)}$ $\quad Z(s) = \frac{V(s)}{I(s)} = \frac{15s^2+45s}{s^2+6s+8}$

$s^2+6s+8=0$ $\quad s=-2,\ s=-4$ — poles

$V_n(t) = A e^{-2t} + B e^{-4t}$

$s=-1$

$V_F(s) = 150\angle 0 * \frac{15(-1)^2-45}{1-6+8} = -1500\,V$

$V_{com} = V_n(t) + V_F(t) = A e^{-2t} + B e^{-4t} - 1500\,e^{-t}$

Q8) Evaluates the poles and zeros of Z_{in} of the circuit shown in Fig.5 [10 %]

10

$Z_{in}(s) = (12+6s) \parallel 2s \parallel 3$

$(12+6s)\parallel(2s) = \dfrac{(12+6s)*2s}{12+8s} = \dfrac{24s+12s^2}{12+8s}$

$12+6s \parallel 2s \parallel 3 = \dfrac{\dfrac{24s+12s^2}{12+8s} * 3}{3 + \dfrac{24s+12s^2}{12+8s}} = \dfrac{3(24s+12s^2)}{36+48s+12s^2}$

zeros $s=0$, $s=-2$

Poles $s=-1$, $s=-3$

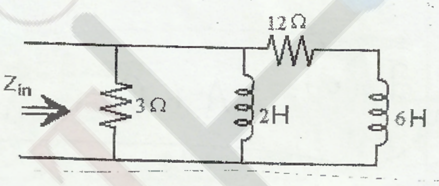


Fig. 5

Q9) For the circuit shown in Fig. 6, evaluate $i_L(t)$ if $i_s(t)$=64Cos(100πt) mA. [15 %]

15

$I_s(t)$ $I_s = 64\angle 0$

$(J12+3)I_L - J12*64\angle 0 + J4\times 64\angle 0 + J4\times 64\angle 0$

$-J4I_L - J4I_L = 0$

$(3+J4)I_L - J4\times 64\angle 0 = 0$

~~$I_L = 64\angle 0$~~

$I_L = 51.2\angle 36.869$ mA

~~$i_L(t) = 64\cos(100\pi t)$ mA~~

$i_L(t) = 51.2\cos(100\pi t + 36.869)$ mA

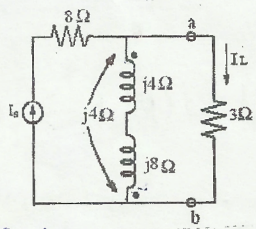


Fig. 6

Q10) Evaluate $i_2(t)$ in the circuit shown in Fig. 7 by installing a suitable source across the points y and y′. Given that $i_1(0)=i_2(0)=1$ A. [20%]

Solution

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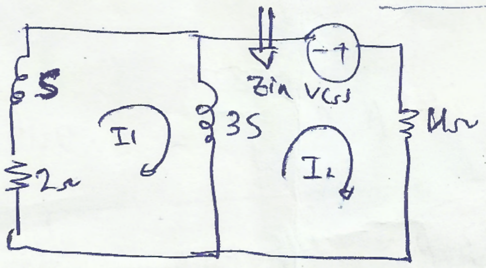

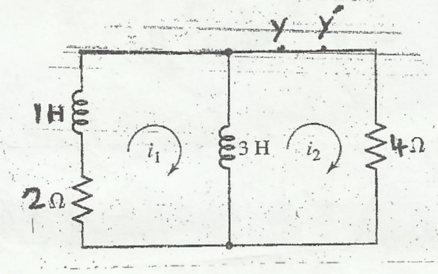

Fig. 7

$\dfrac{I_2(s)}{V(s)} = Y(s) = \dfrac{1}{Z(s)}$

$Z(s) = ((s+2)\parallel 3s) + 4 = \dfrac{3s(s+2)}{4s+2} + 4$

$= \dfrac{3s^2+6s}{4s+2} + 4\left(\dfrac{4s+2}{4s+2}\right) = \dfrac{3s^2+6s+16s+8}{4s+2} = \dfrac{3s^2+22s+8}{4s+2}$

$\dfrac{I_2(s)}{V(s)} = Y(s) = \dfrac{1}{Z(s)} = \dfrac{4s+2}{3s^2+22s+8}$

تكملة الحل خلف الورقة

$$Y(s) = \frac{4s+2}{3s^2+22s+8} = \frac{I_2(s)}{V(s)}$$

$$I_2(s) = A\,e^{-0.3837} + B\,e^{-6.949}$$

$$\boxed{I_2(0) = A + B = 1} \quad \text{--- (1)}$$

$$L_1 \frac{di_1(t)}{dt} + 2i_1(0) + 4i_2(0) = 0$$

$$\boxed{\left.\frac{di_1(t)}{dt}\right|_{t=0} = -6}$$

$$4i_2(0) + 3\frac{di_2(t)}{dt} - 3\frac{di_1(t)}{dt} = 0$$

$$\left.3\frac{di_2(t)}{dt}\right|_{t=0} = -18 - 4 = -22$$

$$\left.\frac{di_2(t)}{dt}\right|_{t=0} = \frac{-22}{3} = -7.33$$

$$\therefore \frac{dI_2(t)}{dt} = -0.383A\,e^{-0.3837} - 6.949\,e^{-6.949}$$

$$\boxed{-7.33 = -0.383A - 6.949B} \quad \text{--- (2)}$$

$A = -0.058$

$B = 1.058$

$$I_2(t) = -0.058\,e^{-0.3837} + 1.058\,e^{-6.949}$$