iii. Find the voltage $v_0(t)$ in the circuit of figure 8 by means of Laplace transform. **5**

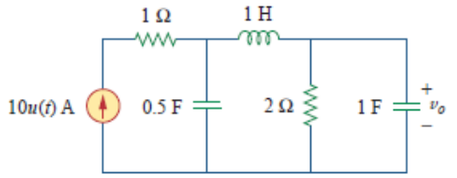

Figure 8

OR iv. Find $vo(t)$, for all $t > 0$, in the circuit of figure 9. **5**

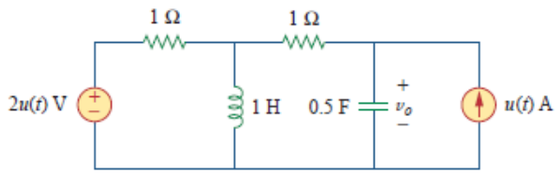

Figure 9

Q.5 i. Define admittance and hybrid parameters for two-port network. **4**

ii. Find I_1 and I_2 in the circuit shown in figure 10. **6**

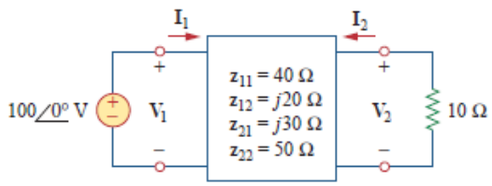

Figure 10

OR iii. Find the transmission parameters for the two-port network shown in figure 11. **6**

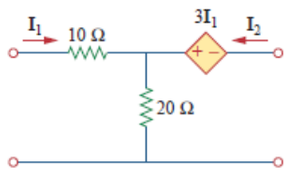

Figure 11

Q.6 i. Define positive real function and write its properties. **2**

ii. Check the following polynomial is Hurwitz or not. **3**

$P(s) = s^5 + s^4 + 8s^3 + 6s^2 + 15s + 8$

iii. Find the Foster first form for the following driving point impedance function: $Z(s) = \frac{2(S^2+1)(S^2+9)}{s(s^2+4)}$ **5**

OR iv. Find the first canonical form of Cauer network for following impedance function: $Z(s) = \frac{S(S^2+3)(S^2+5)}{(S^2+2)(S^2+4)}$ **5**

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Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2017

EC3CO05 / EI3CO05 Circuit Analysis and Synthesis

Programme: B.Tech. Branch/Specialisation: EC/EI

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. In a network consisting of linear resistors and ideal voltage source, if the value of resistors are doubled, then voltage across each resistor **1**

(a) Increases four time (b) Remains unchanged

(c) Doubled (d) Halved

ii. The coefficient of coupling for two coils having $L_1 = 2H$, $L_2 = 8H$ and $M = 3H$ **1**

(a) 0.75 (b) 0.1875 (c) 1.333 (d) 5.333

iii. When the total charge in a capacitor is doubled, the energy stored: **1**

(a) Remains the same (b) Is halved

(c) Is doubled (d) Is quadrupled

iv. A 5-H inductor changes its current by 3 Ain 0.2 s. The voltage produced at the terminals of the inductor is: **1**

(a) 75 V (b) 8.888 V (c) 3 V (d) 1.2 V

v. A source $V_s(t) = V\cos 100\pi t$ has an internal impedance of $(4+j3)\Omega$. If a purely resistive load connected to this source has to extract the maximum power out of the source, its value in Ω should be **1**

(a) 3 (b) 4 (c) 5 (d) 7

vi. The initial value of $f(t)$ with transform $F(s) = \frac{(s+1)}{(s+2)(s+3)}$ is **1**

(a) ∞ (b) 0 (c) 1 (d) 1/6

vii. The current through an *RL* series circuit with input voltage $v(t)$ is given in *s*-domain as: **1**

(a) $V(s)[R + \frac{1}{sL}]$ (b) $V(s)(R+sL)$

(c) $\frac{V(s)}{R + 1/sL}$ (d) $\frac{V(s)}{R + sL}$

viii. When port 1 of a two-port circuit is short-circuited, $I_1=4I_2$ and $V_2=0.25I_2$.Which of the following is true? **1**

(a) $Y_{11}=4$ (b) $Y_{12}=16$ (c) $Y_{21}=16$ (d) $Y_{22}=0.25$

ix. How much inductance is needed to resonate at 5kHz with a capacitance of 12nF? **1**
(a) 2.652 mH (b) 11.844 mH (c) 3.333 mH (d) 84.43 mH

x. The time constant for RL circuit with R = 2Ω and L = 4H is **1**
(a) 2 s (b) 0.5 s (c) 4 s (d) 8 s

Q.2 Attempt any two questions:

i. For the network shown in figure 1 draw the graph and write cut set and tie set matrix. Also write KCL and KVL equations. **5**

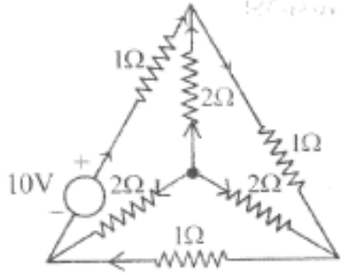


Figure 1

ii. For the circuit of figure 2, determine all four nodal voltages. **5**

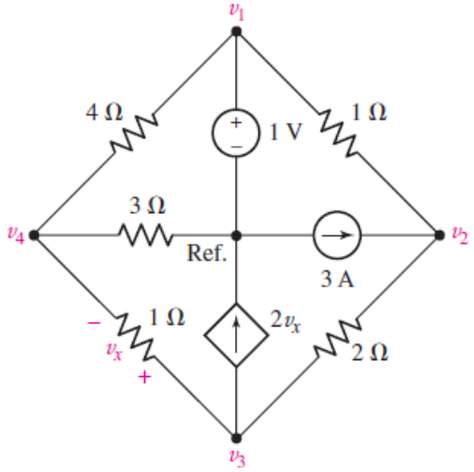


Figure 2

iii. Calculate the phasor currents $\mathbf{I}_1$ and $\mathbf{I}_2$ in the circuit of figure 3. **5**

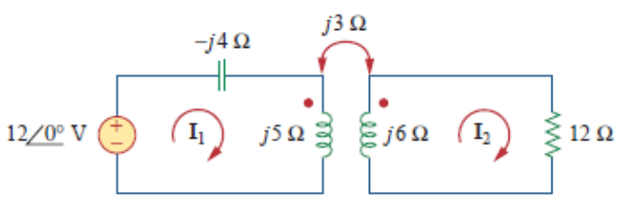


Figure 3

Q.3 Attempt any two questions:

i. The switch in figure 4 has been in position *a* for a long time. At *t=0*, it moves to position *b*. Calculate *i(t)* for all *t>0*. **5**

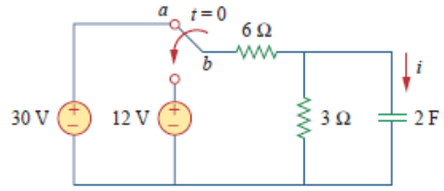


Figure 4

ii. For the circuit in figure 5, find: **5**
(a) $i(0^+)$ and $v(0^+)$, (b) $di(0^+)/dt$ and $dv(0^+)/dt$ (c) $i(\infty)$ and $v(\infty)$

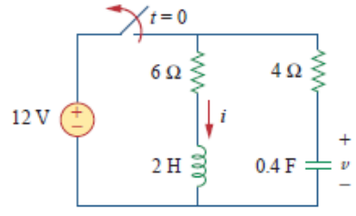


Figure 5

iii Determine the maximum power delivered to the variable resistor *R* shown in the circuit of figure 6. **5**

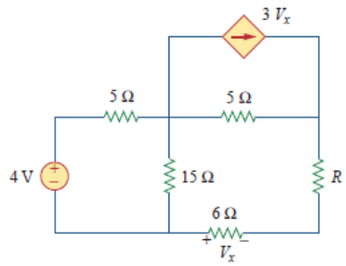


Figure 6

Q.4 i. Express the sawtooth function shown in Figure 7 in terms of singularity function. **2**

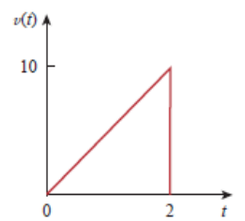


Figure 7

ii. Explain initial value and final value theorem. **3**

EC3CO05 / EI3CO05 Circuit Analysis and Synthesis

Marking Scheme

Q.1	i.	In a network consisting of linear resistors and ideal voltage source, if the value of resistors are doubled, then voltage across each resistor (b) Remains unchanged	**1**
	ii.	The coefficient of coupling for two coils having L_1 = 2H, L_2 = 8H and M = 3H (a) 0.75	**1**
	iii.	When the total charge in a capacitor is doubled, the energy stored: (d) Is quadrupled	**1**
	iv.	A 5-H inductor changes its current by 3 Ain 0.2 s. The voltage produced at the terminals of the inductor is: (a) 75 V	**1**
	v.	A source $V_s(t) = V\cos 100\pi t$ has an internal impedance of $(4+j3)\Omega$. If a purely resistive load connected to this source has to extract the maximum power out of the source, its value in Ω should be (c) 5	**1**
	vi.	The initial value of $f(t)$ with transform F(s) = $\frac{(s+1)}{(s+2)(s+3)}$ is (c) 1	**1**
	vii.	The current through an *RL* series circuit with input voltage $v(t)$ is given in *s*-domain as: (d) $\frac{V(s)}{R+sL}$	**1**
	viii.	When port 1 of a two-port circuit is short-circuited, $I_1=4I_2$ and $V_2=0.25I_2$.Which of the following is true? (b) $Y_{12}=16$	**1**
	ix.	How much inductance is needed to resonate at 5kHz with a capacitance of 12nF? (d) 84.43 mH	**1**
	x.	The time constant for RL circuit with R = 2Ω and L = 4H is (a) 2 s	**1**
Q.2		Attempt any two questions:	
	i.	1 marks for graph 2 marks for cut set matrix and its KCL, KVL equations 2 marks for tie set matrix and its KCL, KVL equations	**5**
	ii.	3 marks for nodal equations 2 marks for solution of those equations.	**5**
	iii.	2 marks for loop equations 3 marks for solution of those equations	**5**
Q.3		Attempt any two questions:	
	i.	1 marks for initial value calculation 1 marks for final value calculation 1 marks for time constant calculation 2 marks for final solution	**5**
	ii.	(a) $i(0^+)$ and $v(0^+)$ - 1 mark (b) $di(0^+)/dt$ and $dv(0^+)/dt$ - 3 marks (c) $i(\infty)$ and $v(\infty)$- 1 mark	**5**
	iii	2 marks for V_{th} calculation 2 marks for R_{th} calculation 1 marks for P_{max} calculation	**5**
Q.4	i.	2 marks for expression	**2**
	ii.	1.5 marks each for initial and final value theorem. (1.5 marks * 2 = 3 marks)	**3**
	iii.	2 marks for initial value calculation 2 marks for Laplace transform 1 mark for inverse Laplace transform.	**5**
OR	iv.	2 marks for initial value calculation 1 marks for Laplace transform 2 marks for inverse Laplace transform.	**5**
Q.5	i.	2 marks each for admittance and hybrid parameters (2 marks * 2 = 4 marks)	**4**
	ii.	3 marks for equations 3 marks for their solutions.	**6**
OR	iii.	2 marks for equations 1 mark for each of the 4 parameters. (1 mark * 4 = 4 marks)	**6**
Q.6	i.	1 mark for definition 1 mark for properties	**2**
	ii.	2 marks for procedure 1 mark for conclusion	**3**
	iii.	4 marks for coefficient calculation 1 marks for synthesis.	**5**
OR	iv.	4 marks for coefficient calculation 1 marks for synthesis.	**5**

Q. 2 (ii) $V_1 = 1V$, $V_2 = 3.085V$, $V_3 = 1.256V$, $V_4 = 0.9512V$

Q. 2 (iii) $I_1 = 13.01 \angle -49.39\ A$, $I_2 = 2.91 \angle 14.04\ A$

Q. 3 (i) $v(0^+) = 10\ V$, $V(\infty) = 4\ V$, $\tau = 4\ sec$, $v(t) = 4 + 6e^{-t/4}\ V$

$i(t) = -3e^{-t/4}\ A$

Q. 3 (ii) (a) 2A, 12V, (b) $-4\ A/s$, $-5\ V/s$, (c) 0A, 0V

Q. 3 (iii) $V_{th} = 3V$, $R_{th} = 104.89\ \Omega$, $P_{max} = 21.45\ mW$

Q. 4 (i) $v(t) = 5t\,u(t) - 5(t-2)u(t-2) - 10\,u(t-2)$

Q. 4 (iii) $V_o(s) = \dfrac{40}{s(2s^3 + s^2 + 6s + 2)}$

$V_o(t) = 40\,u(t) - 39.2e^{-0.339t}u(t) -$

$0.788e^{-0.08t}\cos 1.714t - 7.85e^{-0.08t}\sin 1.714t$

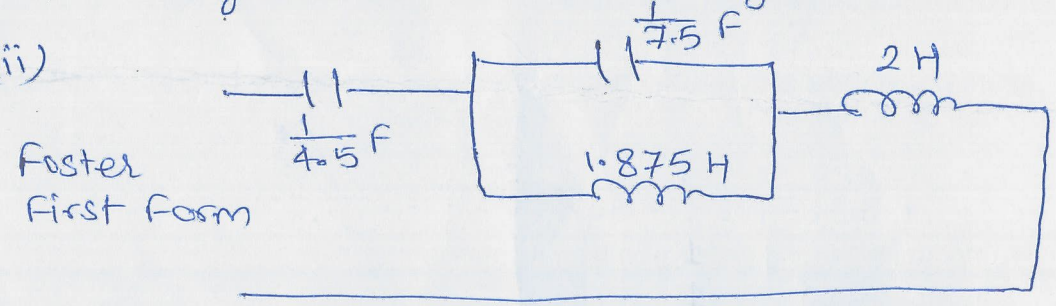
Q. 4 (iv) $V_o(t) = \left(1 - e^{-\frac{3}{4}t}\cos\frac{\sqrt{7}}{4}t + 4.913e^{-\frac{3}{4}t}\sin\frac{\sqrt{7}}{4}t\right)u(t)\ V$

Q. 5 (ii) $I_1 = 2\ A$, $I_2 = -j\ A$ or $1 \angle -90\ A$

Q. 5 (iii) $A = 1.765$, $B = 15.29\ \Omega$, $C = 0.0588\ S$, $D = 1.176$

Q. 6 (ii) Polynomial is Hurwitz.

Q. 6 (iii)



Foster First Form

Q. 6 (iv) Cauer First Form