Duration .... Hours. Total Marks assigned to the paper ....

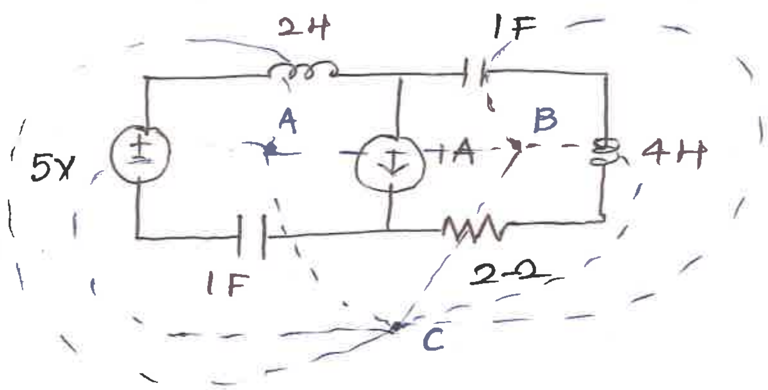
SOLUTION

SEM III, S.E Biomed

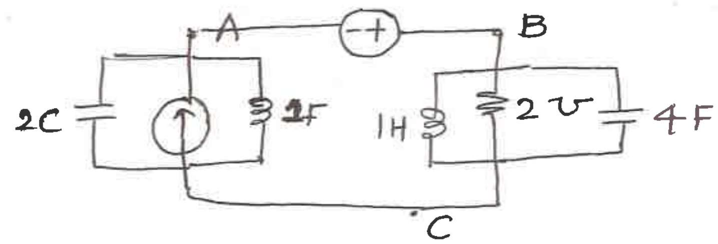
N.B. : Electrical Network Analysis & Synthesis (CBCGS)

Q. No.		Marks
Q.1a)	$Z(s) = \dfrac{15(s+1)(s+0.5+j1.32)(s+0.5-j1.32)}{s(s+4)(s+2)}$	(03)
	zeros at $s = -1,\ -0.5-j1.32,\ -0.5+j1.32$	(02)
	poles at $s = 0,\ -4,\ -2$	

b)



(02)



(03)

c)

$5 + 2I_x = I_x$

$I_x = -5$ —— (02)

$I_x = \dfrac{V_A}{6}$ —— (01)

$V_A = -30$ —— (02)

Q2

1 d) P(s) is a odd polynomial

$$P'(s) = 5s^4 + 9s^2 + 2$$

$$\frac{P(s)}{P'(s)} = 5s^4+9s^2+2 \overline{) s^5+3s^3+2s} \left(s/5 \right.$$

$$s^5 + 9/5 s^3 + 2/5 s$$

$$6/5 s^3 + 8/5 s \overline{) 5s^4+9s^2+2} \left(25/6 s \right.$$

$$5s^4 + \frac{20}{3}s^2$$

$$7/3 s^2 + 2 \overline{) 6/5 s^3 + 8/5 s} \left(18/35 s \right.$$

$$6/5 s^3 + \frac{36}{35}s$$

$$\frac{244}{35}s \overline{) 7/3 s^2 + 2} \left(\frac{245}{732} s \right.$$

$$7/3 s^2$$

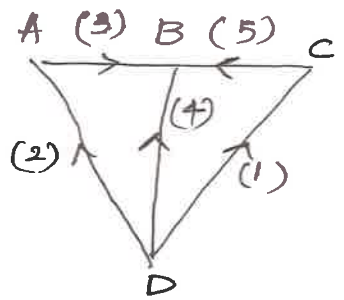
$$2 \overline{) \frac{244}{35}s} \left(\frac{244}{70} s \right.$$

$$\frac{244}{35}s$$

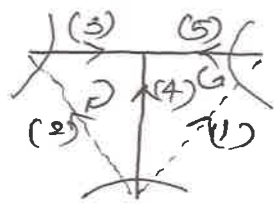
$$0$$

∴ Given polynomial is Hurwitz

Q.2 a) complete incidence matrix is



	1	2	3	4	5
A	0	−1	1	0	0
B	0	0	−1	−1	−1
C	−1	0	0	0	1
D	1	1	0	1	0



	1	2	3	4	5
tieset 2	0	1	1	−1	0
tieset 1	1	0	0	−1	1

	1	2	3	4	5
cutset 3	0	−1	1	0	0
4	0	0	−1	−1	−1
5	−1	0	0	0	1

Q. No. | | Marks

D3

Q.2 b) $V_N = 5V$.

To find I_{sc}.

Apply KCl.

$$I = \frac{V}{5} + 4I_{sc} + I_{sc}$$

$$I_{sc} = 0.1923\,A.$$

$$R_N = \frac{5}{0.1923} = 25.87\Omega$$

$$I_{10\Omega} = 0.1386\,A.$$

$$\therefore P_{10\Omega} = 0.192\,W.$$

Q.3 a) $P_{max} = \frac{V_{TH}^2}{4R_{TH}}$ $R_{TH} = R_L$

b) - Initial values of voltage and current

- response of voltage & current

- initial conditions for R, L & C.

c) Condition of reciprocity for Y - parameters

$Y_{12} = Y_{21}$

condition of symmetry for Y - parameters

$Y_{11} = Y_{22}$

Q.4 a) initialy s/w is open $i(0) = 0$ $\therefore i(0^+) = 0$

at 0^+ s/w is closed, $-m-$ acts as open

$\therefore V_L(0^+) = 100V$.

for $t > 0$ apply KVL

$$100 = 50i + 0.1\frac{di}{dt}$$

$$\frac{di}{dt} + 500i = 1000$$

$$\therefore i(t) = \frac{1000}{500} + Ke^{-500t}$$

$\because i(0) = 0$ $K = 2$

$$\boxed{\therefore i(t) = 2(1 - e^{-500t})}$$

$$V_L = 0.1\frac{d}{dt}(2 - 2e^{-500t})$$

$$= 0.1(0 - 2e^{-500t}(-500))$$

$$\boxed{V_L = 100e^{-500t}}$$

Q.4 b) $i(0^-) = 0 \quad \therefore \quad i(0^+) = 0$

for $t > 0$ apply KVL

$$5 = 2i + \frac{di}{dt}$$

$$5 = 2i(0^+) + \frac{di}{dt}(0^+)$$

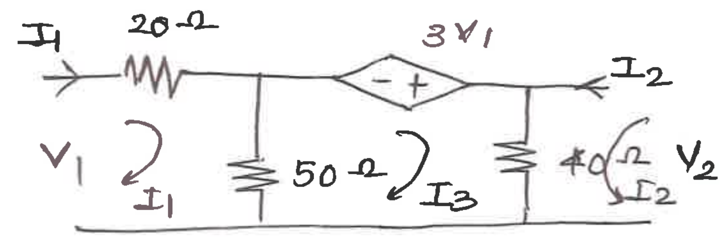
$$\therefore \frac{di}{dt}(0^+) = 5 \text{ A/s.}$$

$$0 = 2\frac{di}{dt} + \frac{d^2i}{dt^2}$$

$$= 2(5) + \frac{d^2i}{dt^2}$$

$$\therefore \frac{d^2i}{dt^2} = -10 \text{ A/s}^2$$

Q.5 a)



$V_1 = Z_{11}I_1 + Z_{12}I_2$

$V_2 = Z_{21}I_1 + Z_{22}I_2$

$$V_1 = 70I_1 - 50I_3 \quad \text{—— (1)}$$

$$V_2 = 40I_2 + 40I_3 \quad \text{—— (2)}$$

$$+50I_1 - 90I_3 - 40I_2 + 3V_1 = 0 \quad \text{—— (3)}$$

$$\frac{50I_1 - 40I_2 + 3V_1}{90} = I_3$$

$$V_1 = 70I_1 - 50\left(\frac{50I_1 - 40I_2 + 3V_1}{90}\right)$$

$$= 70I_1 - \frac{2500I_1}{90} + \frac{2000I_2}{90} + \frac{150}{90}V_1$$

Q. No. | Marks

05

$$V_1 + \frac{150}{90}V_1 = \frac{3800}{90}I_1 + \frac{2000}{90}I_2$$

$$\frac{240}{90}V_1 = \frac{3800}{90}I_1 + \frac{2000}{90}I_2$$

$$V_1 = 15.83I_1 + 8.33I_2$$

$$V_2 = 40I_2 + 40\left(\frac{50I_1 - 40I_2 + 3V_1}{90}\right)$$

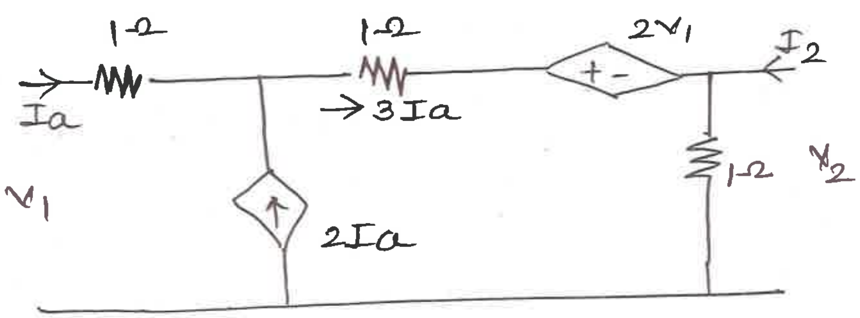
$$= 40I_2 + \frac{2000I_1}{90} - \frac{1600}{90}I_2 + \frac{120}{90}V_1$$

$$= 40I_2 + 22.22I_1 - 17.77I_2 + 1.33(15.83I_1 + 8.33I_2)$$

$$V_2 = 33.33I_2 + 43.27I_1$$

$$Z = \begin{bmatrix} 15.83 & 8.33 \\ 43.27 & 33.33 \end{bmatrix}$$

b)



Applying KVL to outer loop

$$V_1 - Ia - 3Ia - 2V_1 - 3Ia = 0$$

$$V_1 = -7Ia$$

$$V_2 = 3Ia$$

$$\frac{V_2}{V_1} = -3/7 \quad \therefore \quad G_{21} = -3/7.$$

Q. 6 a) Cauer I

$$\cancel{z(s) = \frac{s(s^2+6s+8)}{s^2+3s}}$$

$\cancel{s^2+3s)\ s^3+6s^2+8s\ (s}$

$\cancel{s^3+3s^2}$

$\cancel{3s^2+8s)\ s^3+3s\ (s/3}$

$\cancel{s^3+8}$

$$z(s) = \frac{3(s^2+6s+8)}{s^2+3s}$$

$s^2+3s)\ 3s^2+18s+24\ (3 \leftarrow z(s)$

$3s^2+9s$

$9s+24)\ s^2+3s\ (s/9$ — $Y(s)$

$s^2+\frac{24}{9}s$

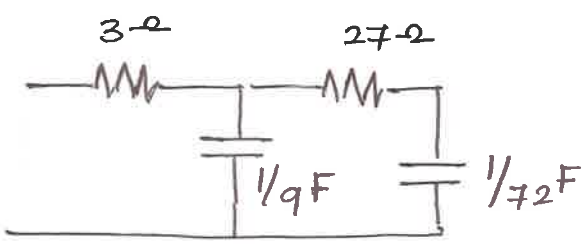
$\frac{1}{3}s)\ 9s+24\ (27$ — $z(s)$

$9s$

$24)\ \frac{1}{3}s\ (\frac{s}{72}$ — $Y(s)$

$\frac{1}{3}s$

0



Q. No.

Marks

07

Q.6 b)

$$Z(s) = \frac{2s+s^3}{3+4s^2+s^4}$$

$$3+4s^2+s^4 \,)\, 2s+s^3 \,(\, 2s/3$$

$$2s + 8/3\, s^3 + \tfrac{2}{3} s^5$$

$$-5/3\, s^3 - \tfrac{2}{3} s^5$$

$$\therefore Y(s) = \frac{3+4s^2+s^4}{2s+s^3}$$

$$2s+s^3 \,)\, 3+4s^2+s^4 \,(\, \frac{3}{2s} \leftarrow Y(s)$$

$$3 + \tfrac{3}{2}s^2$$

$$\tfrac{5}{2}s^2+s^4 \,)\, 2s+s^3 \,(\, \frac{4}{5s} \leftarrow Z(s)$$

$$2s + \tfrac{4}{5}s^3$$

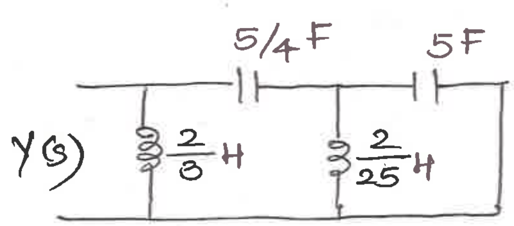
$$\tfrac{1}{5}s^3 \,)\, \tfrac{5}{2}s^2+s^4 \,(\, \frac{25}{2s} \;—\; Y(s)$$

$$\tfrac{5}{2}s^2$$

$$s^4 \,)\, \tfrac{1}{5}s^3 \,(\, \frac{1s}{5s} \;—\; Z(s)$$

$$\tfrac{1}{5}s^3$$

$$0$$



Q.6 c) $\frac{P_2(s)}{P_1(s)} = \frac{s^2+1}{s^3+4s}$ $\begin{matrix} \leftarrow \text{even fun.} \\ \leftarrow \text{odd fun.} \end{matrix}$ $2s$ $s^2+1/2s$ — Hurwitz.

08

$P_1'(s) = 3s^2+4$.

$$3s^2+4 \overline{)\, s^3+4s \,} \left(s/3\right.$$
$$s^3+\tfrac{4}{3}s$$
$$\tfrac{8}{3}s \overline{)\, 3s^2+4 \,} \left(9/8\, s\right.$$
$$3s^2$$
$$4 \overline{)\, 8/3\, s \,} \left(\tfrac{2}{3}s\right.$$
$$8/3\, s$$
$$0$$

$\therefore$ Hurwitz.

$$F(s) = \frac{(s+j)(s-j)}{s(s^2+4)} = \frac{(s+j)(s-j)}{s(s+j2)(s-j2)}$$

poles at $s=0$, $s=-j2$, $s=+j2$

$\therefore$ on $j\omega$ axis.

$\therefore$ residue test.

$A = 1/4$, $B = 3/8$, $C = 3/8$

residues are real & +ve

Even part (s^2+1) 0   odd part (s^3+4s) 0

$\therefore A(\omega^2) \geq 0$ for all $\omega \geq 0$

$\therefore F(s)$ is P.R.F.