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P. No. 50071

* SOLUTION *

$$Q.1 (a) \cdot I_1 = \frac{V_1 - 50}{30}$$

$$\cdot \frac{V_1}{5} + \frac{V_1 + 30I_1}{10} + \frac{V_1 - 50}{30} - 2 = 0$$

$$\boxed{V_1 = 20V}$$

$$\cdot \boxed{V_{5\Omega} = V_1 = 20V}$$

$$(b) \cdot v(0^+) = 0$$

$$\cdot \frac{dv}{dt}(0^+) = 10 \times 10^6 \text{ V/s}$$

$$\cdot \frac{d^2v}{dt^2}(0^+) = -10 \times 10^9 \text{ V/s}^2$$

(c)

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 1/4 & 5/2 \\ 5/4 & 3/2 \end{bmatrix}$$

$$(d) K = 500\Omega$$

$$f_c = 3.18 \text{ kHz}$$

$$PB = 0 \text{ to } 3.18 \text{ kHz}$$

$$Q.2 (a) Z_L = 1.41 + j0.43 \Omega$$

$$P_{max} = 4.91 \text{ W}$$

$$Q.2 (b): z_1(s) = \frac{2s^2 + 3}{s^2 + 3s + 1} \quad z_2(s) = \frac{s+1}{s^2 + 3s + 1} \quad z(s) = z_1(s) + z_2(s) = 1$$

$$\frac{V_2(s)}{V_1(s)} = \frac{s+1}{s^2 + 3s + 1}$$

$$Q.3 (a): \begin{bmatrix} 0.45 - j0.5 & -0.25 \\ -0.25 & 0.75 + j0.5 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 10 \angle 0^\circ \\ 0.5V_2 \end{bmatrix}$$

$$V_2 = 26.26 \angle 113.2^\circ \text{ V}$$

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02

Q.3 (b): polynomial is not Hurwitz due to sign change in first column.

Q.3 (c): poles: $s = -0.25 + j1.4$
 $s = -0.25 - j1.4$

Q.4 (a): • condition for reciprocity in z-parameters is

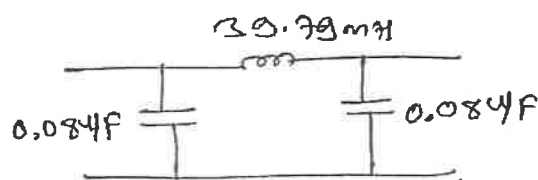
$$z_{12} = z_{21}$$

• condition for symmetry in h-parameters.

$$h_{11}h_{22} = h_{12}h_{21} + 1$$

$$\text{or } h_{11}h_{22} - h_{12}h_{21} = 1$$

Q.4 (b): • $L = 39.99 \text{ mH}$, $C = 0.164 \mu\text{F}$



$$\bullet Z_{0K} \Big|_{f=2000 \text{ Hz}} = 577.35 \Omega$$

$$\bullet Z_{0K} \Big|_{f=6000 \text{ Hz}} = j447.21 \Omega$$

$$\bullet \alpha \Big|_{f=2 \text{ kHz}} = 0 \quad \bullet \alpha \Big|_{f=6 \text{ kHz}} = 1.925$$

Q.5 (a):

• for 18V source,

$$V_x^I = 3 \text{ V}$$

• for 5A source,

$$V_x^{II} = -5 \text{ V}$$

• for 36V source,

$$V_x^{III} = -6 \text{ V}$$

$$\bullet V_x = -8 \text{ V}$$

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Q. 5 (b)

$$\frac{V_1}{I_1} = \frac{6s^4 + 57s^2 + 8}{14s^2 + 2}$$

$$\frac{V_2}{I_1} = \frac{s^2}{6s^4 + 57s^2 + 8}$$

$$\frac{V_2}{I_1} = \frac{s}{14s^2 + 2}$$

Q. 6 (a): $V_c(0^-) = 20V = V_c(0^+)$

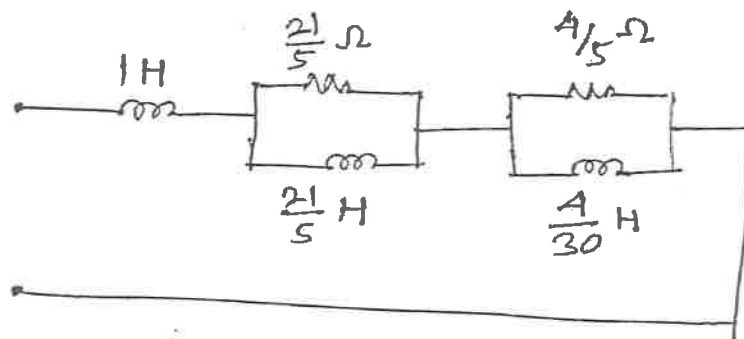
$$i(0^-) = 0 = i(0^+)$$

$$\frac{di(0^+)}{dt} = 10 A/s$$

$$i(t) = 2.02 e^{-0.03t} - 2.02 e^{-4.97t} \quad t > 0$$

Q. 6 (b)

Foster I form:



Cauer I form:

