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Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Circuits and Controls

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1   a. Briefly explain the types of sources in electric circuit. **(05 Marks)**

     b. Use mesh analysis to determine mesh currents in the circuit shown in Fig.Q.1(b).
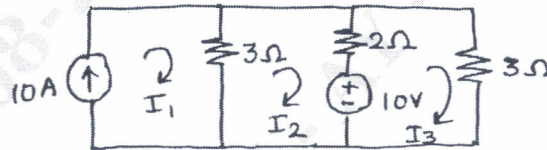

Fig.Q.1(b)

(10 Marks)

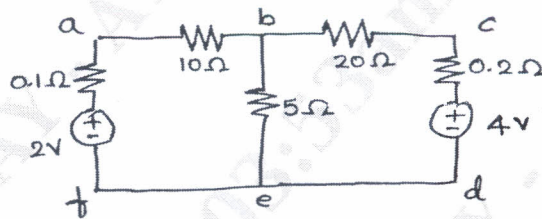   c. Use Norton's theorem to determine current through branch 'b-e' in the circuit shown in Fig.Q.1(c).

Fig.Q.1(c)

(05 Marks)

OR

2   a. State and explain Thevenin's theorem. **(10 Marks)**

     b. What should be the value of pure resistive load to be connected across the terminals a and b in the network shown in the Fig.Q.2(b), so that the maximum power is transferred to the load? What is the maximum power?
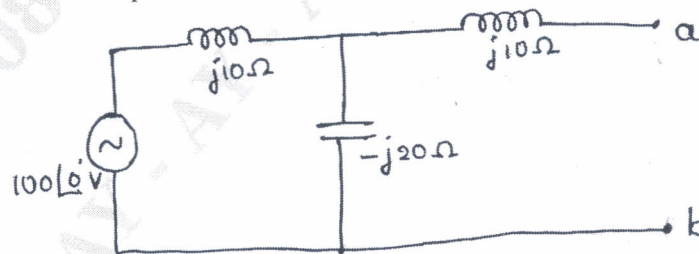

Fig.Q.2(b)

(10 Marks)

Module-2

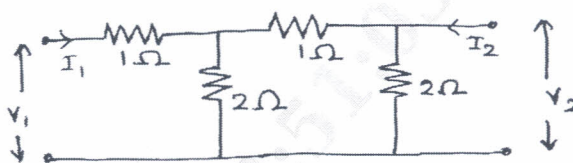**3** a. For the network of Fig.Q.3(a), determine z-parameters

Fig.Q.3(a)

(08 Marks)

b. Obtain Laplace transform of i) Unit step function   ii) Unit impulse function.   (04 Marks)
c. State and prove initial and final value theorems.   (08 Marks)

OR

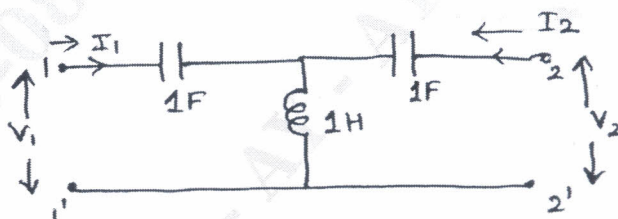**4** a. Find the h-parameters of the network shown in Fig.Q.4(a).

Fig.Q.4(a)

(10 Marks)

b. In the series RL circuit shown in the Fig.Q.4(b), the source voltage is $v(t) = 50 \sin 250t$ V. Determine the resulting current if the switch is closed at $t = 0$.
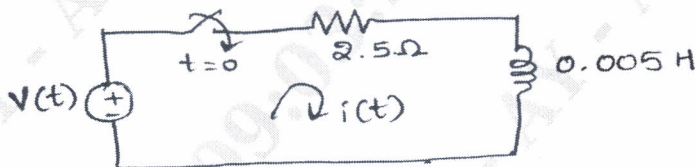

Fig.Q.4(b)

(10 Marks)

Module-3

5 a. Compare closed loop and open loop control systems. Give one example for each.   (06 Marks)

b. Find the transfer function $\dfrac{V_o(S)}{V_i(S)}$ for the system shown in Fig.Q.5(b) with buffer amplifier of gain K.
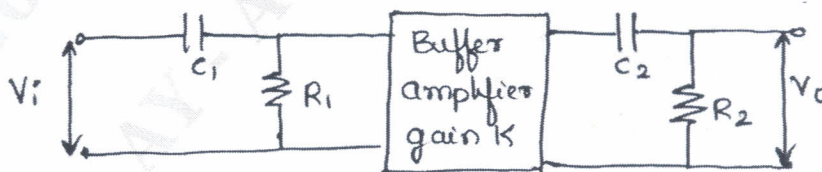

Fig.Q.5(b)

(06 Marks)

c. Draw a block diagram for the electric circuit shown in Fig.Q.5(c) and evaluate the transfer function $\dfrac{E_o(S)}{E_i(S)}$.
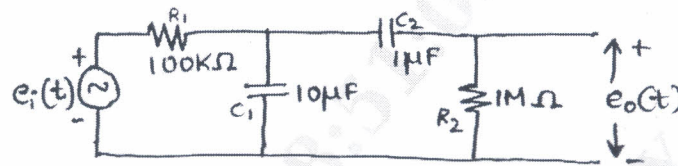

Fig.Q.5(c)

(08 Marks)

OR

6 a. What are the effects of negative feedback in control system? (05 Marks)

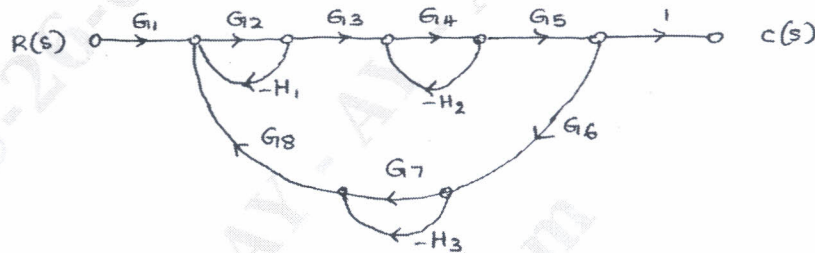b. Obtain the transfer function for the signal flow graph shown in Fig.Q.6(b) using Mason's gain formula.

Fig.Q.6(b)

(10 Marks)

c. Illustrate force to current analogy. (05 Marks)

Module-4

7 a. Derive an expression for time response of an under damped second order system for a unit step input. (08 Marks)

b. Check the stability of the system defined by the equation $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$ using R-H criterion. (06 Marks)

c. Derive an expression for rise time (t_r) of an underdamped second order system. (06 Marks)

OR

8 a. For a unity feedback control system with $G(S) = \dfrac{64}{S(S+9.6)}$, write the output response to a unit step input. Determine :

i) The response at t = 0.1 sec.

ii) Maximum value of the response and time at which it occurs.

iii) Settling time. (08 Marks)

b. Explain Routh-Hurwitz criterion for stability of the system and mention its limitations. (04 Marks)

c. A unity feedback system has $G(S) = \dfrac{K(S+13)}{S(S+3)(S+7)}$. Using Routh's criterion calculate the range of K for which the system is i) Stable ii) has its closed loop poles more negative than − 1. (08 Marks)

Module-5

9 a. Sketch the complete root locus of the system having $G(S)H(S) = \dfrac{K}{S(S+1)(S+2)(S+3)}$

(10 Marks)

b. Write short note on lead lag compensator. (04 Marks)

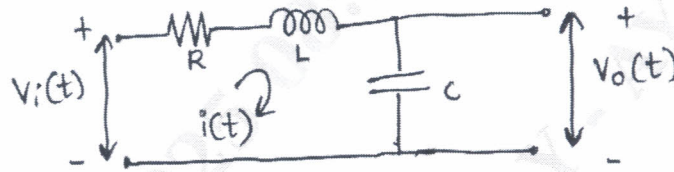c. Obtain the state model of the given electrical system as shown in Fig.Q.9(c). (06 Marks)

Fig.Q.9(c)

OR

10 a. A unity feedback control system has $G(S) = \dfrac{80}{S(S+2)(S+20)}$. Draw the Bode plot. Determine GM, PM, Wgc and Wpc and also comment on the stability. (10 Marks)

b. A linear time invariant system is characterized by the homogeneous state equation:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Obtain the solution of homogeneous equation by assuming the initial state vector $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.

(06 Marks)

c. Explain any four rules for construction of root loci. (04 Marks)

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