CBCS SCHEME

USN | | | | | | | | | | |

21EC43

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).

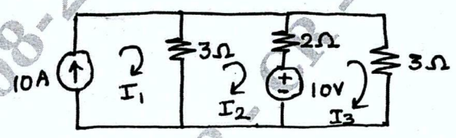

Fig.Q.1(b)

(10 Marks)

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

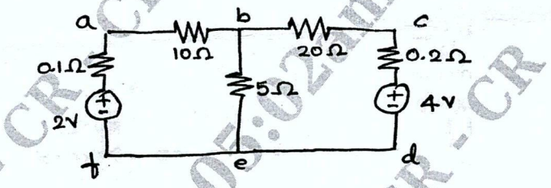

Fig.Q.1(c)

(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?

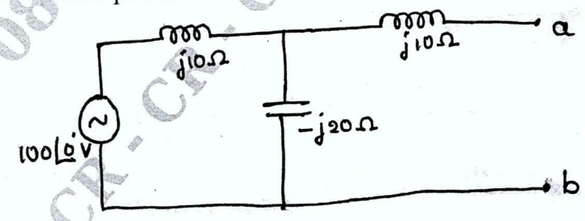

Fig.Q.2(b)

(10 Marks)

Module-2

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

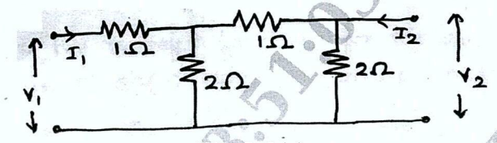

Fig.Q.3(a)

(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).

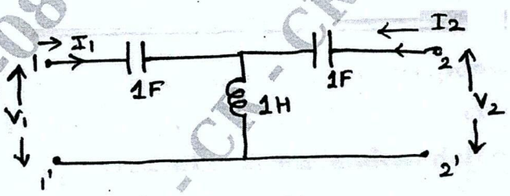

Fig.Q.4(a)

(10 Marks)

b. In the series RL circuit shown in the Fig.Q.4(b), the source voltage is v(t) = 50 sin250t V. Determine the resulting current if the switch is closed at t = 0.

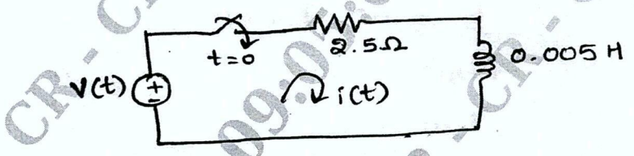

Fig.Q.4(b)

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

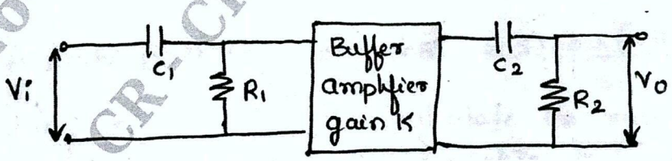

Fig.Q.5(b)

(06 Marks)

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

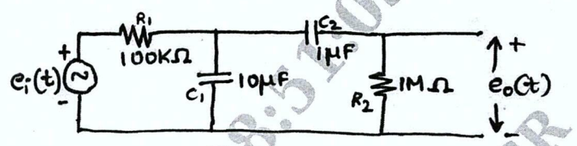

Fig.Q.5(c)

(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.

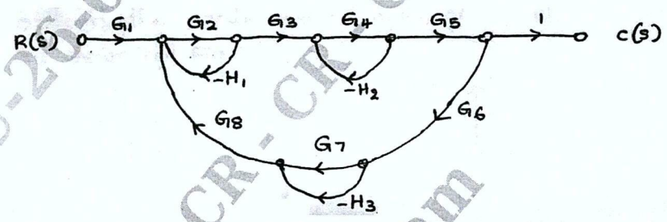

Fig.Q.6(b)

(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 $G(S) = \frac{64}{S(S+9.6)}$, 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 $G(S) = \frac{K(S+13)}{S(S+3)(S+7)}$. 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 $G(S)H(S) = \frac{K}{S(S+1)(S+2)(S+3)}$ **(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)**

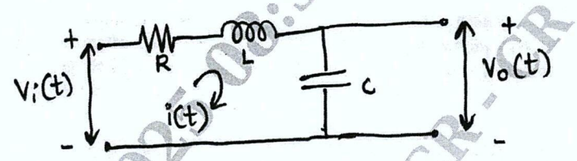

Fig.Q.9(c)

OR

10 a. A unity feedback control system has $G(S) = \frac{80}{S(S+2)(S+20)}$. 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)**

* * * * *