# CBCS SCHEME

## Fourth Semester B.E. Degree Examination, June/July 2024
## 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. With help of circuits explain independent electrical sources. **(06 Marks)**
   b. Using mesh current analysis, find the currents in various branches and node voltages at 'a' and 'b' points shown in Fig.Q.1(b). **(08 Marks)**
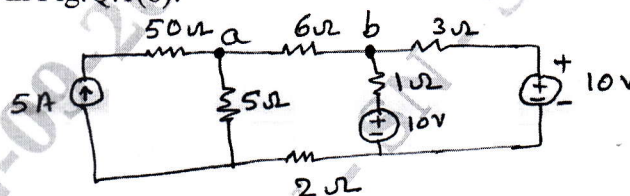


Fig.Q.1(b)

   c. Using mesh current analysis, find the current in $(2 + j3)\Omega$ shown in Fig.Q.1(c). **(06 Marks)**
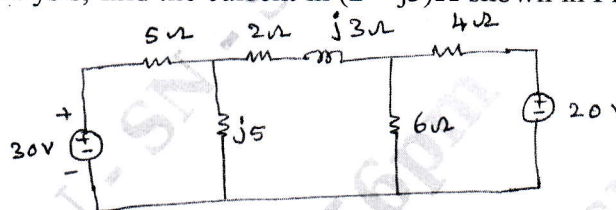


Fig.Q.1(c)

### OR

2  a. State and explain Thevenin's theorem. **(08 Marks)**
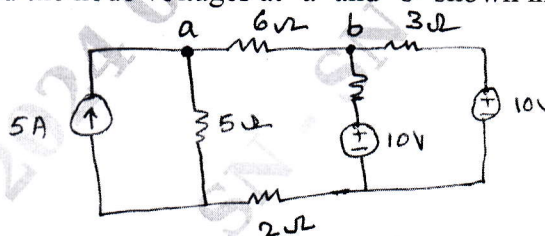   b. Using nodal analysis, find the node voltages at 'a' and 'b' shown in circuit Fig.Q.2(b). **(08 Marks)**



Fig.Q.2(b)

   c. Define and explain briefly, the super position theorem. **(04 Marks)**

### Module-2

3  a. Find the Z-parameters of given circuit shown in Fig.Q.3(a). **(08 Marks)**
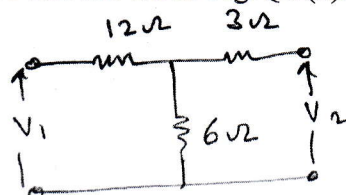


Fig.Q.3(a)

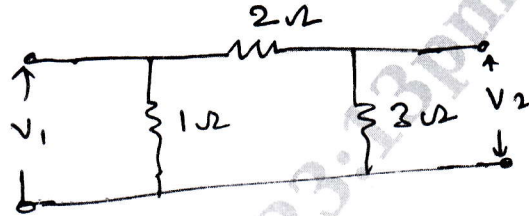b.  Find the Y-parameters of circuit shown in Fig.Q.3(b). **(08 Marks)**



Fig.Q.3(b)

c.  Explain the standard test signals unit step, unit ramp and unit impulse. **(04 Marks)**

## OR

4  a.  Define and prove that initial value theorem and final value theorem. **(08 Marks)**
   b.  Find the expression for current when switch 'SW' is closed at t = 0 shown in Fig.Q.4(b). (Use Laplace transform). **(08 Marks)**
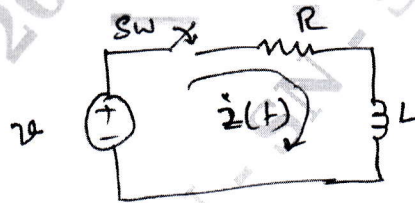


Fig.Q.4(b)

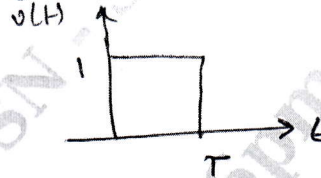c.  Obtain the Laplace transform of a gate function shown in Fig.Q.4(c). **(04 Marks)**



Fig.Q.4(c)

## Module-3

5  a.  What is control system? List the differences between open loop control system and closed loop control system with examples. **(10 Marks)**
   b.  Determine the overall transfer function shown in the Fig.Q.5(b) using block diagram reduction technique. **(10 Marks)**
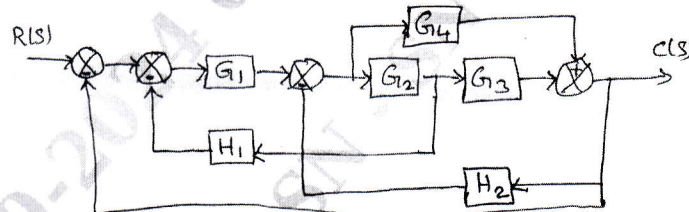


Fig.Q.5(b)

## OR

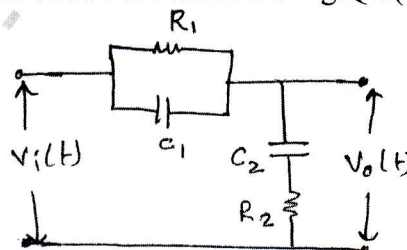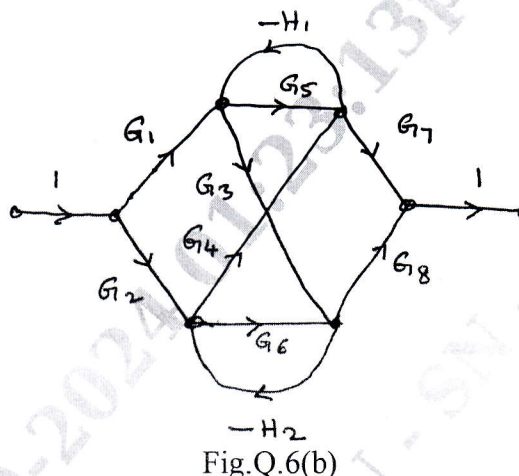6  a.  Find the transfer function of the circuit shown in the Fig.Q.6(a). **(10 Marks)**



Fig.Q.6(a)

b. Find the overall gain of the SFG system shown in the Fig.Q.6(b) using Mason's gain formula. **(10 Marks)**



Fig.Q.6(b)

## Module-4

7  a. Derive the expression for underdamped second order system with unit step input. **(10 Marks)**

b. Discuss the stability of the closed loop system as a function of K for the open loop transfer function using RH criterion.

$$G(S)H(S) = \frac{K(S+1)}{S(S-1)(S^2 + 4S + 16)}$$

**(10 Marks)**

**OR**

8  a. A vfb system having transfer function

$$\frac{C(S)}{R(S)} = \frac{2}{S(S^2 + PS + 4K)}$$ is marginally stable and oscillates with frequency 2 rad/sec. Find $K_{mar}$ and 'P' using RH criterion. **(10 Marks)**

b. Starting from the output equation C(t) derive expressions for: i) Rise time $(t_r)$   ii) Peak overshoot. **(10 Marks)**

## Module-5

9  a. Sketch the complete root locus of the system having open loop transfer function

$$G(S)H(S) = \frac{K}{S(S+1)(S+2)(S+3)}$$ and determine values of K for which the system is stable.

**(16 Marks)**

b. Construct the state model using phase variable if the system is described by the difference equation

$$\frac{d^3 y(t)}{dt^3} + 4\frac{d^2 y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 2y(t) = 5U(t)$$

**(04 Marks)**

**OR**

10  Plot the Bode magnitude and phase diagram for a open loop transfer function

$$G(S)H(S) = \frac{10(1+0.5S)}{S(1+0.25S)(1+0.2S)}$$

**(20 Marks)**

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