

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Circuits and Controls

Time: 3 hrs.

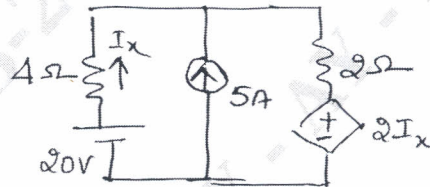
Max. Marks: 100

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

Module-1

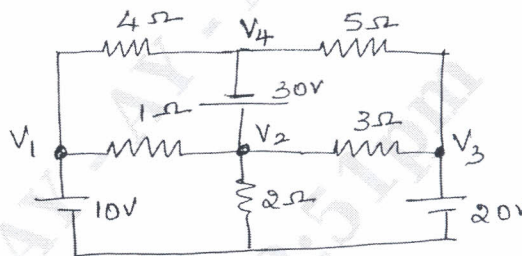
- 1 a. State superposition theorem and using superposition theorem, determine I_x for the circuit in Fig. Q1(a). (08 Marks)

Fig. Q1(a)



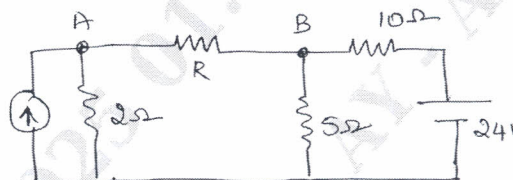
- b. Determine the node voltages for the network shown in Fig. Q1(b) using nodal analysis. (06 Marks)

Fig. Q1(b)



- c. Find the value of R such that maximum power transfer can take place for the circuit shown in Fig. Q1(c). Also find the maximum power delivered. (06 Marks)

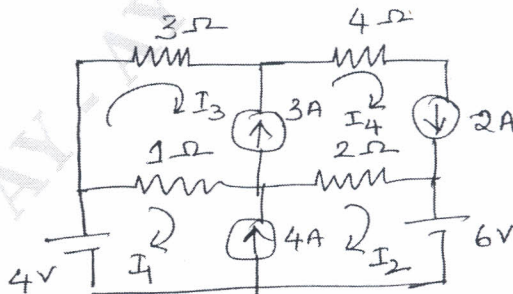
Fig. Q1(c)



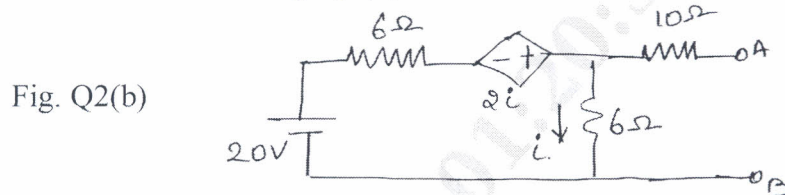
OR

- 2 a. Determine the mesh current for the network shown in the Fig. Q2(a) using mesh analysis method. (06 Marks)

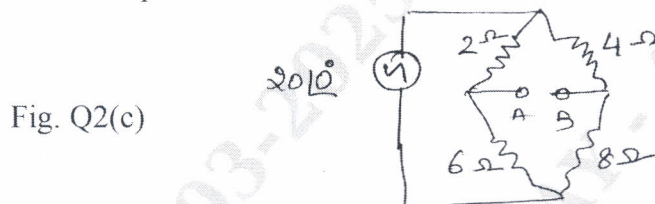
Fig. Q2(a)



- b. State Thevenin's theorem and determine the Thevenin's equivalent network between A & B for the network shown in Fig. Q2(b). (08 Marks)

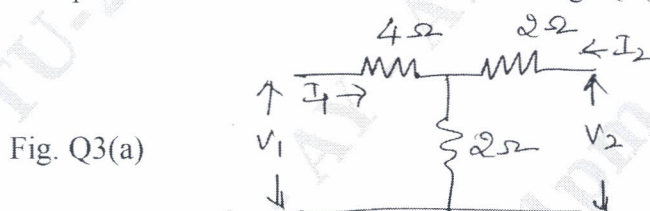


- c. Obtain Norton's equivalent circuit for the network shown in Fig. Q2(c). (06 Marks)



Module-2

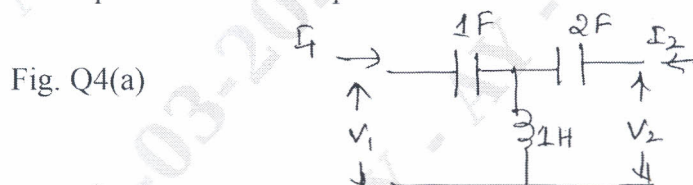
- 3 a. Determine 'Z' parameter for the network shown in Fig. Q3(a). (06 Marks)



- b. Given $I(s) = \frac{2s+5}{(s+1)(s+2)}$. Determine the initial and final value of $i(t)$ using initial and final value theorem. (08 Marks)
- c. For the given Z parameter equation, find ABCD parameter.
 $V_1 = 6I_1 + 20I_2$
 $V_2 = 20I_1 + 40I_2$. (06 Marks)

OR

- 4 a. Determine Z parameter and 'h' parameter for the network shown in Fig. Q4(a). (10 Marks)



- b. Determine 'Z' and 'Y' parameter for the network shown in Fig. Q4(b). (10 Marks)

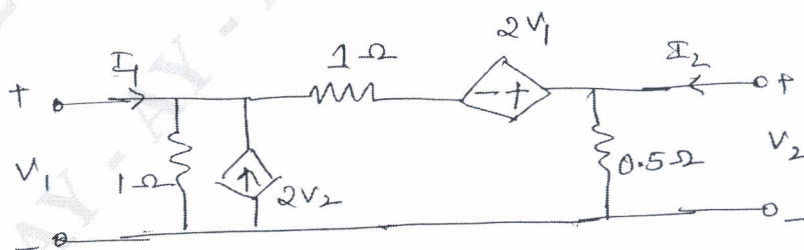
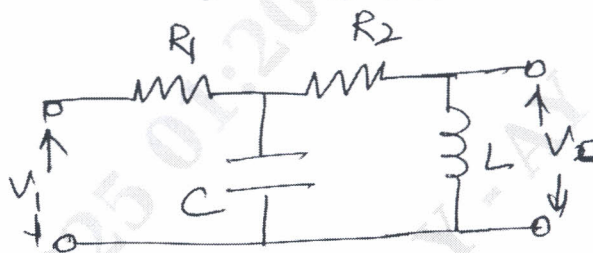


Fig. Q4(b)

Module-3

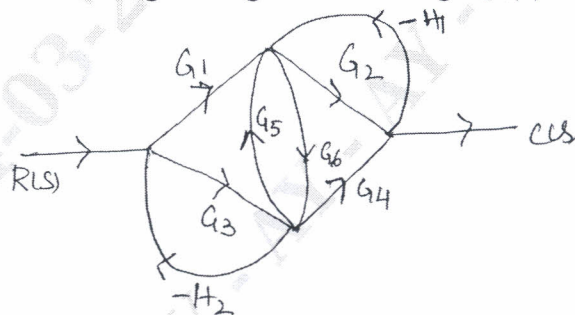
- 5 a. Define Open loop system and closed loop system and mention all the merits and demerits of open loop and closed loop system. (06 Marks)
- b. Write differential equation for the network given in Fig. Q5(b). (06 Marks)

Fig. Q5(b)



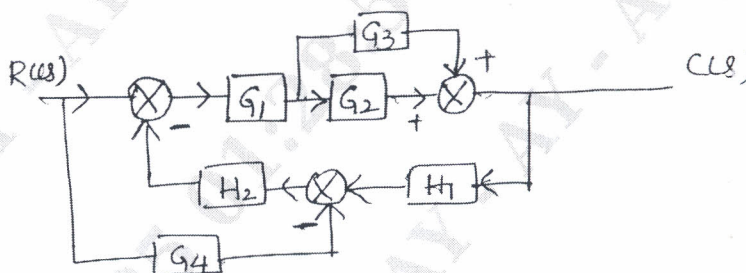
- c. Obtain transfer function for the given signal flow in Fig. Q5(c). (08 Marks)

Fig. Q5(c)

**OR**

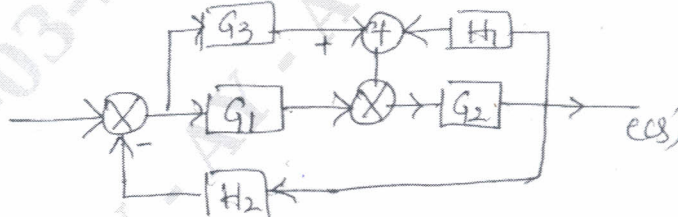
- 6 a. Simplify the given block as shown in Fig. Q6(a) using block reduction method and find its transfer function. (10 Marks)

Fig. Q6(a)



- b. Draw signal flow graph for the given block as shown in Fig. Q6(b) and obtain transfer function using Mason's Gain formula. (10 Marks)

Fig. Q6(b)

**Module-4**

- 7 a. Obtain the time response of a second order system subjected to unit step input for under damped oscillation. (08 Marks)
- b. Check the stability of the given characteristic equation using Routh Hurwitz criteria. The characteristic equation is $F(s)$.
 $F(s) = s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16$. Also find roots on RHS, LHS and on imaginary axis. (06 Marks)

- c. A second order system is given by

$$\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}. \text{ Find Rise time, Settling time, Peak over shoot and Peak time.}$$

(06 Marks)

OR

- 8 a. Using RH criteria find K_{mar} and 'w' at K_{mar} given characteristic equation $s^4 + 22s^3 + 10s^2 + s + k = 0$.

(06 Marks)

- b. For a system having $G(s) = \frac{15}{(s+1)(s+3)}$ and $H(s) = 1$.

Find W_n , damping ratio ζ , W_d and θ . Also find $C(t)$, T_p , M_p and T_s (for 2% variance).

(08 Marks)

- c. For the given characteristics equation $F(s) = s^2 + 4s + 4$. Using RH criteria determine the stability of the system and determine roots lying between $S = 0$ and $S = -1$.

(06 Marks)

Module-5

- 9 a. Obtain the Root locus for the given transfer function

$$G(s)H(s) = \frac{K}{s(s+3)(s^2 + 3s + 11.25)}$$

Find the range of 'K' for stability.

(10 Marks)

- b. Find the state model equation for the differential equation given below :

$$\frac{dy^4}{dt^4} + 10\frac{d^3y}{dt^3} + 10\frac{d^2y}{dt^2} + \frac{dy}{dt} + y(t) = 10x(t).$$

(10 Marks)

OR

- 10 a. Find the state transition matrix for

$$A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$$

(08 Marks)

- b. Explain properties of state transition matrix.

(06 Marks)

- c. A unity feedback control system has $G(s) = \frac{80}{s(s+2)(s+20)}$.

Draw a Bode plot and find W_{gc} and W_{pc} . Comment on stability.

(06 Marks)
