



CBCS SCHEME

21EE52

Fifth Semester B.E./B.Tech. Degree Examination, June / July 2026 Control Systems

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Distinguish between Open Loop and Closed Loop Control Systems with examples. (08 Marks)
- b. For the rotational mechanical system shown in fig. Q. 1 (b), draw the electrical network based on torque – current analogies. Give all necessary cause – effect equations.

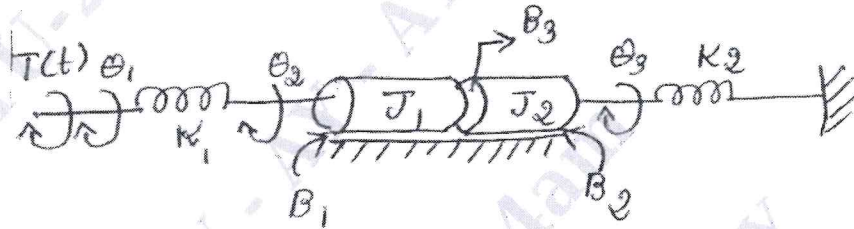


Fig. Q. 1 (b)

(12 Marks)

OR

- 2 a. Derive the transfer function of armature controlled DC servomotor. (08 Marks)
- b. Draw the mechanical network for the mechanical system shown in fig. Q. 2 (b). Draw the analogous electric circuit in which force is analogous to current.

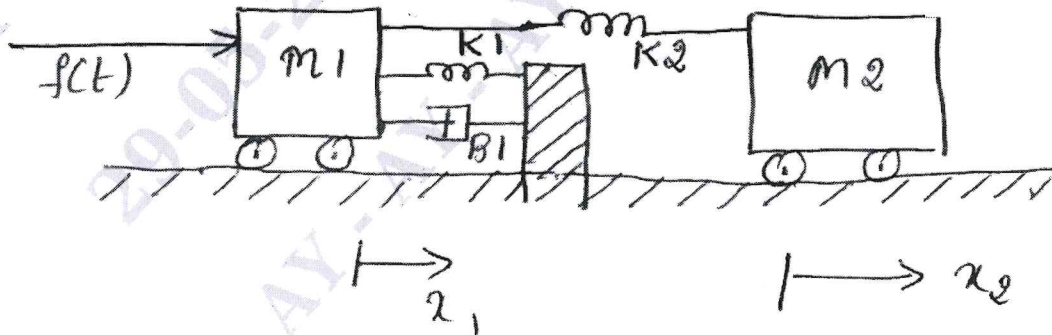


Fig. Q. 2 (b)

(12 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-2

- 3 a. Reduce the block diagram shown in fig. Q. 3 (a) and then find $\frac{C}{R}$.

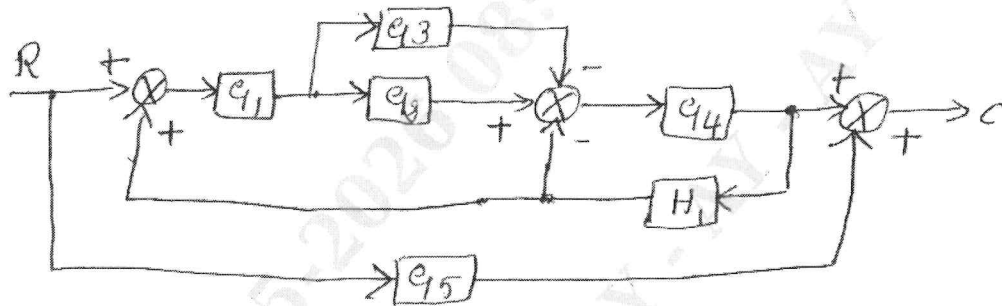


Fig. Q. 3 (a)

(08 Marks)

- b. Find the transfer function $\frac{C(s)}{R(s)}$ for the signal flow graph shown in fig. Q. 3 (b).

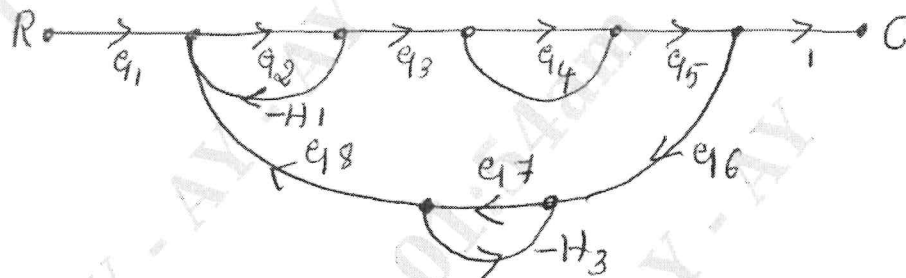


Fig. Q. 3 (b)

(08 Marks)

- c. Define : i) Source and sink node ii) Loop and forward path.

(04 Marks)

OR

- 4 a. Obtain the transfer function $\frac{C(s)}{R(s)}$ using block diagram reduction method.

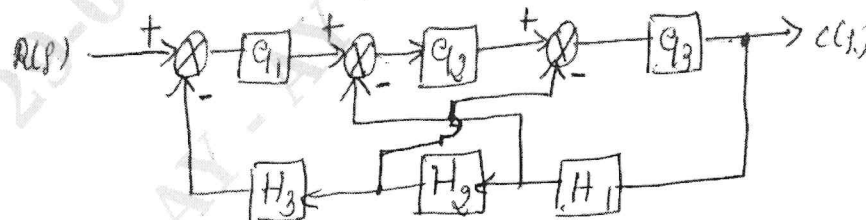


Fig. Q. 4 (a)

(08 Marks)

- b. Illustrate how to perform following connection with block diagram reduction technique.
- Combining blocks in parallel
 - Moving a summing point after a block.
 - Assuming point with three inputs
 - Eliminating a feedback loop
- (08 Marks)
- c. Explain Mason's gain formula indicating each term. (04 Marks)

Module-3

- 5 a. Derive an expression for rise time and maximum overshoot for a second order system excited by a step input [underdamped case] (08 Marks)
- b. A unity negative feedback control system is characterized by an open loop transfer function $G(s)H(s) = \frac{K}{S(S+10)}$. Determine system gain 'K' such that damping ratio is 0.5. For this K value find rise time, peak time, settling time and peak overshoot. Assume system is subjected to IV. (07 Marks)
- c. Investigate the stability of a closed loop system whose characteristic equation is given by $s^5 + 3s^4 + 7s^3 + 20s^2 + 6s + 15 = 0$ (05 Marks)

OR

- 6 a. Explain the difficulties encountered while solving using R – H criterion and how do you eliminate these difficulties with example. (08 Marks)
- b. For the characteristic equation given by $s^4 + 25s^3 + 15s^2 + 20s + K = 0$, determine
- The range of K so that system is stable asymptotically
 - The value of 'K' so that system is marginally stable and frequency of sustained oscillations. (07 Marks)
- c. Derive the expression for step response, rise time and settling time of a first order system. (05 Marks)

Module-4

- 7 a. A negative feedback control system is characterized by $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. Sketch the root locus plot for all values of K ranging from 0 to ∞ . Mark all salient points on root locus. (14 Marks)
- b. Explain the following terms with respect to root locus.
- Breakaway point
 - Asymptotes
 - Angle of departure
- (06 Marks)

OR

- 8 a. Derive an expression for resonant peak and band width for a second order system. (08 Marks)
- b. Using bode plots investigate the stability of negative feedback control system. Whose open – loop transfer function is given by $G(s)H(s) = \frac{50}{s(0.5s+1)(0.05s+1)}$. (12 Marks)

Module-5

- 9 a. Using Nyquist stability criterion, investigate the stability of a closed loop transfer function whose open loop transfer function is given by $G(s)H(s) = \frac{10}{(s+1)(s+2)}$ (12 Marks)
- b. Explain the steps to solve problems using Nyquist criterion. (08 Marks)

OR

- 10 a. Explain PID controller and discuss the effect of this on the behaviour of the system. (10 Marks)
- b. Explain the step by step design procedure of lead compensating network. (10 Marks)
