

CBCS SCHEME

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18EE61

Sixth Semester B.E. Degree Examination, June/July 2024 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 system with an example. (08 Marks)
 - b. For the mechanical system shown in Fig.Q1(b), write the differential equation relating to the force $F(t)$. Also obtain the analogous electrical networks based on :
 - i) Force-voltage analogy
 - ii) Force-current analogy.

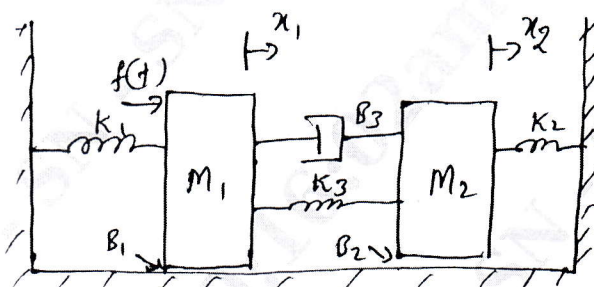


Fig.Q1(b)

(12 Marks)

OR

- 2
 - a. List the features of transfer function. (04 Marks)
 - b. Derive the transfer function of armature controlled DC motor. (08 Marks)
 - c. For the rotational mechanical system shown in Fig.Q2(c), draw an electrical network based on Torque-voltage analogy.

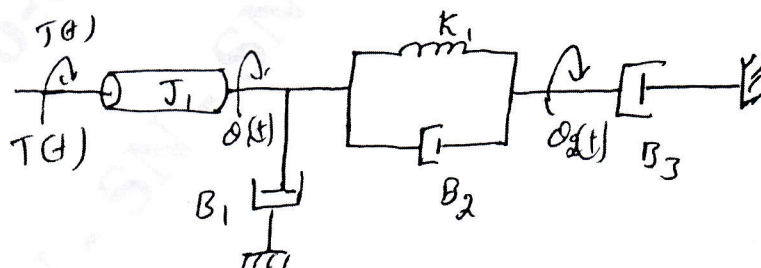


Fig.Q2(c)

(08 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. Explain the following block diagram reduction techniques :

- Combining blocks in parallel
- Moving a summing point behind a block
- Eliminating a feedback loop.

(06 Marks)

- b. Obtain the transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig.Q3(b). Using block diagram reduction technique.

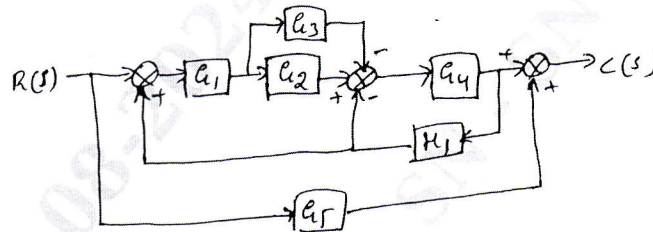


Fig.Q3(b)

(08 Marks)

- c. Find the overall transfer function for the signal flow graph shown in Fig.Q3(c), using Masons Gain formula.

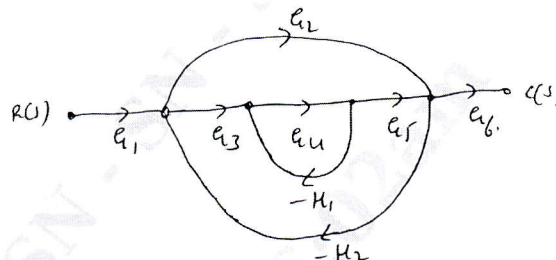


Fig.Q3(c)

(06 Marks)

OR

- 4 a. For the electrical network shown in Fig.Q4(a), find $\frac{V_o(s)}{V_i(s)}$ using Masons Gain formula.

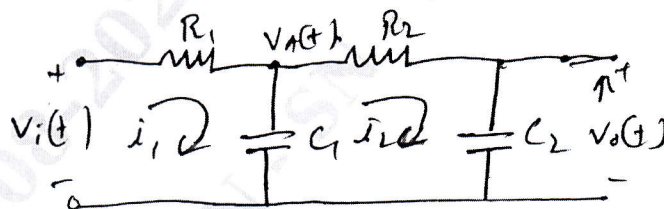


Fig.Q4(a)

(10 Marks)

- b. Using block diagram reduction technique, obtain the transfer function $C(s)/R(s)$ for the block diagram shown in Fig.Q4(b).

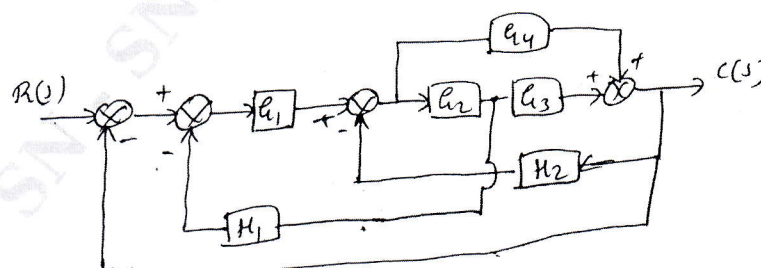


Fig.Q4(b)

(10 Marks)

Module-3

- 5 a. Derive an expression for the following time domain specification second order system :
- Rise time
 - Peak time
 - Maximum overshoot.
- (12 Marks)
- b. Determine the stability of the system using Routh's stability criterion for the characteristic equation : $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. (08 Marks)

OR

- 6 a. For a negative units feedback control system with $G(s) = \frac{50}{s(s+5)}$, find the following :
- Percentage overshoot for a unit step input
 - Settling time for a unit step input
 - Steady state error for an input $r(t) = r(t) = 2 + 4t + 6t^2$ for $t \geq 0$.
- (12 Marks)
- b. Find the range of 'K' for which the system, whose characteristic equation is given by $S^3 + (K + 0.5)s^2 + 4KS + 50 = 0$ is stable. (08 Marks)

Module-4

- 7 a. A negative feedback control system is characterized by
- $$G(s) \cdot H(s) = \frac{k}{s(s^2 + 2s + 2)}$$
- Sketch the root locus plot for values of 'K' ranging from 0 to ∞ and comment on stability. (12 Marks)
- b. Derive an expression for resonant peak and resonant frequency for a second order system. (08 Marks)

OR

- 8 a. A negative feedback control system is characterized by an open loop transfer function :
- $$G(s) \cdot H(s) = \frac{k}{s(s+1)(0.1s+1)}$$
- Draw the bode plot and determine :
- The value of k to give a GM of 10dB
 - The value of K to give a PM of 24° .
- (14 Marks)
- b. What are break away points and break in points. Explain how to find them. (06 Marks)

Module-5

- 9 a. A feedback control system has open loop transfer function :
- $$G(s) \cdot H(s) = \frac{1}{s(s+1)}$$
- Sketch the Nyquist plot and comment on the stability of the system. (10 Marks)
- b. Explain lag and lag-lead compensator. (10 Marks)

OR

- 10 a. Explain PIP controllers. (10 Marks)
- b. State explain Nyquist stability criterion. (05 Marks)
- c. List the effects of lead compensator. (05 Marks)
