

USN

Course Code 2 2 E E 5 3

Fifth Semester B.E. Degree Examinations, February 2025

CONTROL SYSTEMS

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
 2. Missing data, if any, may be suitably assumed

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>
Module-1			
1. a.	Differentiate between open loop and closed loop control systems. Give examples for each.	06	(2 : 1 : 1.4.1)
b.	For the mechanical system shown in Fig. Q1 (b) draw the mechanical network, write the differential equations and hence obtain analogous electrical system based on force current analogy.	14	((3 : 1 : 1.4.1)

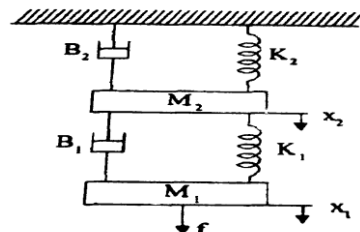


Fig. Q 1(b)

(OR)

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|----|---|----|-----------------|
| 2. | a. Give the classification of control systems. | 06 | (2 : 1 : 1.4.1) |
| | b. For the rotational mechanical system shown in Fig.Q2 (b), draw mechanical network and write the differential equations governing the system. Draw equivalent electrical system based on Torque- Voltage analogy. | 14 | (3 : 1 : 1.4.1) |

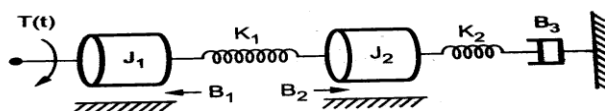


Fig. Q 2(b)

Module-2

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|----|--|----|-----------------|
| 3. | a. A system is represented by the following equations. Construct the signal flow graph and determine the transfer function $X_4(s)/X_1(s)$. | 10 | (3 : 2 : 1.4.1) |
|----|--|----|-----------------|

$$\begin{aligned}
 x_2 &= a_{21}x_1 + a_{23}x_3 \\
 x_3 &= a_{31}x_1 + a_{32}x_2 + a_{33}x_3 \\
 x_4 &= a_{42}x_2 + a_{43}x_3
 \end{aligned}$$

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|----|--|----|-----------------|
| b. | Obtain the transfer function $Y(s)/R(s)$ for the block diagram shown in Fig. Q3 (b) using block diagram reduction technique. | 10 | (3 : 2 : 2.1.2) |
|----|--|----|-----------------|

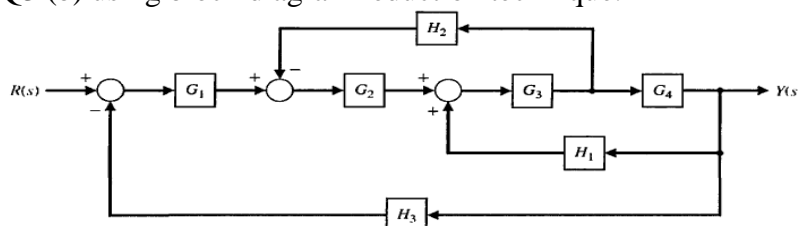


Fig. Q3 (b)

(OR)

4. a. Using block diagram reduction technique obtain the transfer function of the block diagram shown in Fig. Q4 (a). 10 (3 : 2 : 1.4.1)

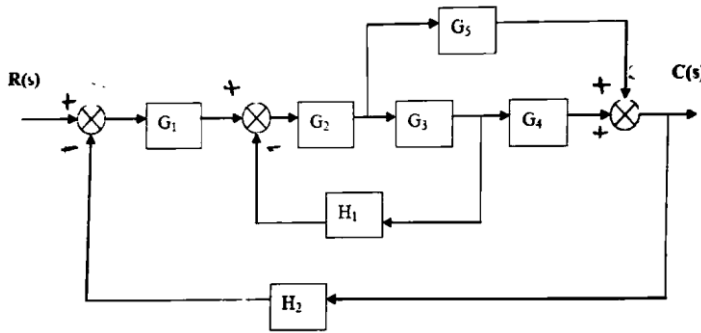


Fig. Q4(a)

- b. For the signal flow graph shown in Fig. Q4 (b), determine the transfer function. 10 (3 : 2 : 1.4.1)

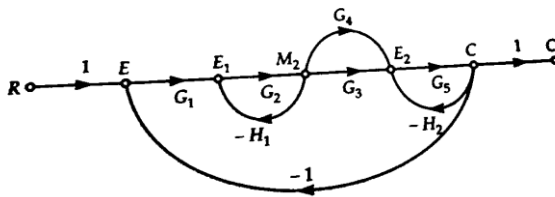


Fig. Q 4(b)

Module-3

5. a. Explain standard test signals. 04 (2 : 3 : 1.4.1)
b. Forward path gain of a unity feedback system is given by $G(s) = \frac{10}{s^2 + 2s + 10}$. Determine rise time, peak time and peak overshoot of the system when subjected to unit step input. 10 (3 : 4 : 1.4.1)
c. Characteristic equation of a closed loop control system is given by $s^4 + s^3 + Ks^2 + s + 1 = 0$. Using Routh's criterion determine the range of K for stability. 06 (3 : 4 : 1.4.1)

(OR)

6. a. Explain static error constants and steady state error. 04 (2 : 3 : 1.4.1)
b. Open loop transfer function of a control system is given by $G(s)H(s) = \frac{10}{s(1+20s)(1+50s)}$. Determine static error constants. Also, determine steady state error for the input $r(t) = 2+5t$ 10 (3 : 3 : 1.4.1)
c. Open loop transfer function of a control system is given by $G(s)H(s) = \frac{K}{s(s+1)(2s+1)(3s+1)}$. Using Routh's criterion determine the range of k for stability. 06 (3 : 4 : 1.4.1)

Module-4

7. a. The open loop transfer function of a closed loop system is given by $G(s)H(s) = \frac{K}{s(s+10)(s+20)}$. Sketch the complete root locus. 14 (3 : 3 : 1.4.1)
b. What is gain margin and phase margin. Explain how these are determined. 06 (2 : 3 : 1.4.1)

(OR)

8. a. The open loop transfer function of a system is given by 14 (3 : 3 : 1.4.1)

$$G(s) = \frac{100}{s(1+0.01s)(1+0.05s)}$$
. Sketch the Bode plot
- b. Explain how do you determine angle of asymptote and centroid while sketching root locus plot. 06 (2 : 3 : 1.4.1)

Module-5

9. a. Sketch Nyquist plot of a system having open loop transfer function 12 (3 : 4 : 2.1.2)
 $G(s)H(s) = K / (s+1)(s+2)$ and determine the range of K for stability.
- b. Write a note on proportional plus derivative controller. 08 (2 : 5 : 1.4.1)

(OR)

- 10 a. The open loop transfer function of a control system is given by 12 (3 : 4 : 2.1.2)

$$G(s)H(s) = \frac{K(s+1)}{s^2(s+4)(s+2)}$$
. Sketch Nyquist plot and hence determine the range of K for which the system is stable.
- b. Explain compensation using phase lead controller. 08 (2 : 5 : 1.4.1)

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