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Course Code

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Seventh Semester B.E. Degree Examinations, February 2025

CONTROL ENGINEERING

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>(RBTLCO:PI)</u>
Module-1			
1. a.	Define control system. With example, explain open and closed loop control system.	10	(1 :1: 1.6.1)
b.	List the different types of controllers. With suitable mathematical expression explain PI and PD controllers.	10	(1 :1: 1.6.1)
OR			
2. a.	A thermometer is dipped in a vessel containing liquid at constant temperature of " $\theta_i(t)$ ". The thermometer has a capacitance for storing heat as " C " and thermal resistance to limit heat flow as " R ". If the temperature indicated by the thermometer is " $\theta_o(t)$ ", Obtain the transfer function of the system.	10	(2 :1: 1.6.1)
b.	Write the differential equations governing the behaviour of the mechanical system shown in Fig. Q2 (b). Also obtain the analogous electrical circuit based on force voltage analogy and loop equations.	10	(2 :1: 1.6.1)

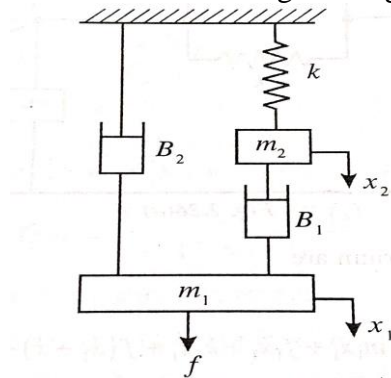


Fig. Q2(b)

Module-2

3. a. Reduce the block diagram by reduction technique and find the overall transfer function shown in Fig. Q3 (a).

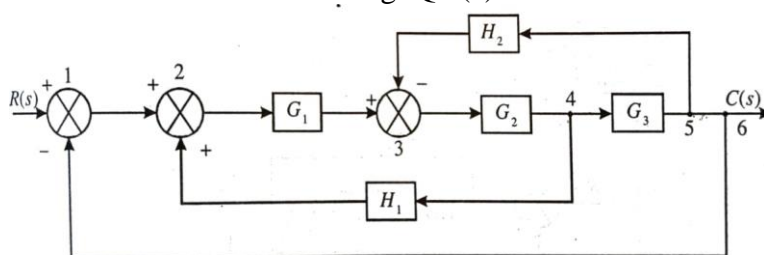


Fig. Q3(a)

- b. Determine the transfer function of the system shown in Fig. Q3 (b) using Mason's gain formula. 10 (3 :2: 1.6.1)

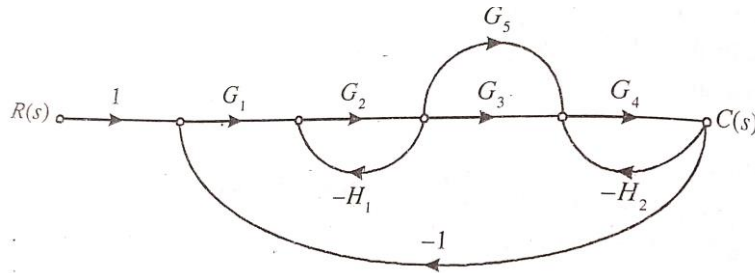


Fig. Q3(b)

OR

4. a. Define Node, Branch, Forward path, Path gain, Loop gain, Self-loop, Feedback loop, Non-touching loop and also explain Mason's gain Formulae. 10 (1 :2: 1.6.1)
- b. Reduce the block diagram by reduction technique and find the overall transfer function shown in Fig Q4 (b). 10 (1:2: 1.6.1)

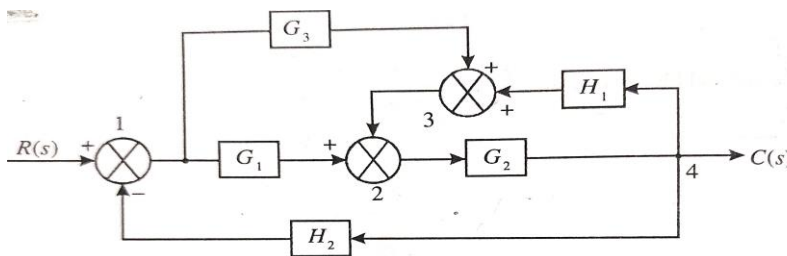


Fig. Q4(b)

Module-3

5. a. List and explain the various standard inputs used in control system analysis. 06 (1 :3: 1.6.1)
- b. Derive an expression for transient response of first order system subjected to unit step input. 06 (2 :3: 1.6.1)
- c. A unity feedback system has 08 (3 :3: 1.6.1)

$$G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$$

Determine (i) Type of system (ii) All error constants (iii) Steady state error for ramp input with magnitude 4

OR

6. a. Explain with the help of neat sketch transient response specifications of a second order underdamped system. 10 (2 :3: 1.6.1)
- b. A unity feedback system is characterised by an open loop transfer function $G(s) = 10/s^2 + 2s + 6$. Determine the following, when the system is subjected to a unit step input (i) Undamped natural frequency (ii) Damping ratio (iii) Peak overshoot (iv) Peak time (v) Settling time 10 (3 :3: 1.6.1)

Module-4

7. a. Investigate the stability of the system using Ruth Hurwitz criterion having the following characteristic equation : 06 (2 :4: 1.6.1)

$$s^5 + 4s^4 + 12s^3 + 20s^2 + 30s + 100 = 0$$

- b. Sketch the root locus plot for a **14** (3 :4: 1.6.1)

$$G(S)H(S) = \frac{K}{S(S+2)(S+4)(S+6)}$$

For what value of k the system becomes unstable?

OR

8. a. Check the stability of the system having characteristic equation **06** (2 :4: 1.6.1)
 $S^6 + 2S^5 + 8S^4 + 12S^3 + 20S^2 + 16S + 16 = 0$

- b. Sketch the root locus plot for a **14** (3 :4: 1.6.1)

$$G(S)H(S) = \frac{K}{S(S+1)(S+2)(S+3)}$$

For what value of k the system becomes unstable?

Module-5

- 9 a Using Nyquist criterion, investigate the stability of a system whose open loop transfer function **10** (2 :5: 1.6.1)

$$G(S)H(S) = \frac{K}{(S+1)(S+2)(S+3)}$$

- b Sketch the polar plot for the given transfer function of a control system **10** (3 :5: 1.6.1)

$$G(S) = \frac{12}{S^2(S+1)(S+2)}$$

OR

- 10 a. Construct Bode plot on a semi log graph paper for a unity feedback system, whose open loop transfer function is given by **20** (3 :5: 1.6.1)

$$G(S)H(S) = \frac{10}{S(1+s)(1+0.02S)}$$

From the Bode plot determine (i) Gain and phase cross over frequencies

(ii) Gain and phase margin (iii) Stability of the closed loop system.

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