CBCS SCHEME

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17ME73

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Control Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the terms system and control system with an example. **(04 Marks)**

b. Explain open loop and closed loop systems with an example. **(08 Marks)**

c. What are the requirements of a control system? Explain them briefly. **(08 Marks)**

OR

2 a. Draw the block diagram of proportional plus derivative (PD) controller and explain its effect on the system. **(10 Marks)**

b. Draw the block diagram of proportional plus derivative plus integral (PID) controller and explain its effects on the system. **(10 Marks)**

Module-2

3 a. Write the equilibrium equations for the mechanical system shown in Fig.Q3(a), hence obtain the F – I system.

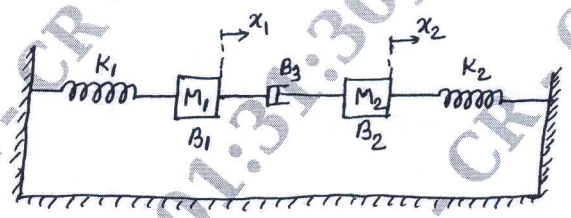

Fig.Q3(a) **(10 Marks)**

b. Derive the transfer function of liquid level system with interaction. **(10 Marks)**

OR

4 a. Reduce the block diagram shown in Fig.Q4(a) and obtain C(s)/R(s).

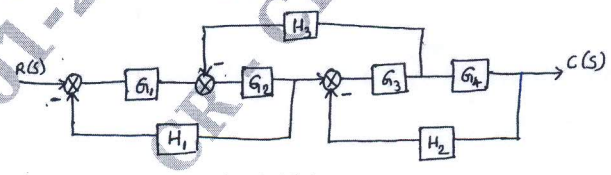

Fig.Q4(a) **(10 Marks)**

b. Find the transfer function by using Mason's gain formula for the signal flow graph shown in Fig.Q4(b).

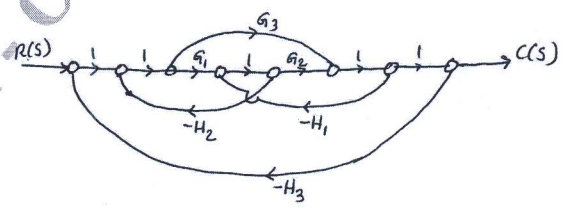

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Obtain an expression for response of first order system for Ramp input. **(06 Marks)**

b. Determine the damping ratio and natural frequency for the system whose maximum overshoot value is 0.2 and peak time is 1 sec. **(06 Marks)**

c. State whether the system is stable or unstable by using Routh's Criteria.
$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0.$ **(08 Marks)**

OR

6 For a unity feedback system,

$$G(s)H(s) = \frac{k}{s(s+2)(s+4)}$$

Sketch the rough nature of the root locus, showing all details on it. **(20 Marks)**

Module-4

7 a. Plot the polar plot of given transfer function :

$$G(s)H(s) = \frac{1}{s(1+3s)}.$$ **(06 Marks)**

b. For a Certain control system :

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

Sketch the Nyquist plot and comment on stability. **(14 Marks)**

OR

8 Construct bode diagram for a feedback control system having its open loop transfer function

$$G(s)H(s) = \frac{100(10s+1)}{s(s+0.4)(s+1)(s+10)}$$

Also determine gain margin and phase margin. **(20 Marks)**

Module-5

9 a. What is compensator? How are the compensators classified? **(08 Marks)**

b. Explain lead compensator. **(06 Marks)**

c. Explain lead – lay compensator. **(06 Marks)**

OR

10 a. A system is governed by the differential equation

$$\frac{d^3y}{dt^3} + \frac{6d^2y}{dt^2} + \frac{11dy}{dt} + 10y = 8u(t)$$

Where y is the output and u is the input of the system. Obtain a state space representation of the system. **(08 Marks)**

b. Determine the state controllability and observability of the system described by :

$$\dot{X} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} X + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u, \quad Y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix} x.$$ **(12 Marks)**

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