CBCS SCHEME

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18ME71

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
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. Explain closed loop system with an example. **(06 Marks)**

b. What are the ideal requirements of a control system? Explain them briefly. **(06 Marks)**

c. Explain proportional plus integral plus derivative control action with the characteristics. **(08 Marks)**

OR

2 a. Draw the equivalent mechanical system of the given system shown in Fig.Q2(a). Hence the set of equilibrium equations for it and obtain electrical analogous circuits using (i) F-V analogy (ii) F-I analogy.

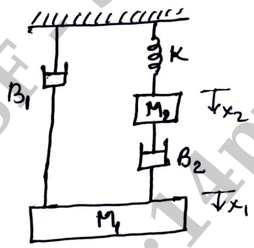

Fig.Q2(a) **(12 Marks)**

b. A thermometer is dipped in a vessel containing liquid at a constant temperature of $\theta_i(t)$. The thermometer has a thermal capacitance for storing heat as 'C' and thermal resistance to limit heat flow as R. If the temperature indicated by the thermometer is $\theta_0(t)$. Obtain the transfer function of the system. **(08 Marks)**

Module-2

3 a. Obtain an expression for response of first order system for unit step input. **(06 Marks)**

b. Explain different types of input signals. **(06 Marks)**

c. Obtain an expression for response of first order system for parabolic input. **(08 Marks)**

OR

4 a. Derive the expression of steady state error for a simple closed loop system and state the factors on which it depends. **(10 Marks)**

b. A second order system has natural frequency ω_n = 5 rad/sec and damping ratio is 0.6. Calculate (i) Delay time (ii) Rise time (iii) Peak time (iv) Maximum overshoot. **(10 Marks)**

Module-3

5 a. Reduce the given block diagram shown in Fig.Q5(a) and obtain the transfer function C(s)/R(s).

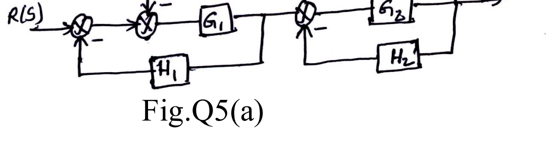

Fig.Q5(a) **(10 Marks)**

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.

b. Find the overall transfer function by using Mason's gain formula for the signal flow graph shown in the Fig.Q5(b).

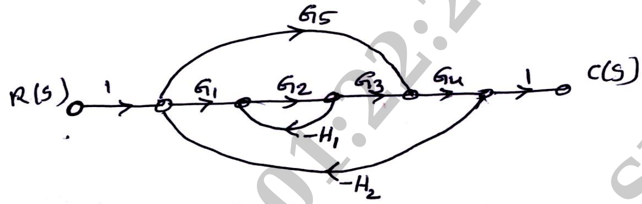

Fig.Q5(b) **(10 Marks)**

OR

6 a. Draw the corresponding signal flow graph of a given block diagram in Fig.Q6(a) and obtain transfer function by using Mason's gain formula.

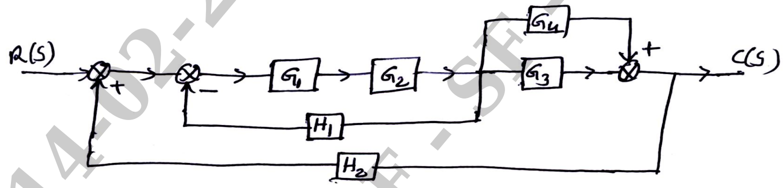

Fig.Q6(a) **(10 Marks)**

b. A system is governed by the differential equation $\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+11\frac{dy}{dt}+10y=8u(t)$ where y is the output and u is the input of the system. Obtain a state space representation of the system. **(10 Marks)**

Module-4

7 a. The characteristic equation of a system is given by

$$s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$$

Determine the stability using RH criteria. **(08 Marks)**

b. By applying Routh criterion, discuss the stability of the closed loop system as a function of K for the following open loop transfer function $G(s)H(s)=\frac{K(s+1)}{s(s-1)(s^2+4s+16)}$ **(12 Marks)**

OR

8 Sketch the rough nature of root locus of a given transfer function

$$G(s)H(s)=\frac{K(s+1)}{s(s+2)(s^2+2s+5)}$$ **(20 Marks)**

Module-5

9 a. Sketch the polar plot of given transfer function

$$G(s)H(s)=\frac{1}{s(1+5s)(1+10s)}$$ **(06 Marks)**

b. The transfer function $G(s)H(s)=\frac{10}{s(s+1)(s+2)}$

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

OR

10 Draw the Bode plot for the transfer function

$$G(s)=\frac{36(1+0.2s)}{s^2(1+0.05s)(1+0.01s)}$$

From Bode plot determine :

(i) Phase crossover frequency (ii) Gain crossover frequency
(iii) Gain margin (iv) Phase margin **(20 Marks)**