CBCS SCHEME

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18ME71

Seventh Semester B.E. Degree Examination, June/July 2024
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. Describe the classification of control systems. **(08 Marks)**

b. Enumerate the difference between open loop and closed loop control systems. **(06 Marks)**

c. Explain PID controllers with characteristic curves. **(06 Marks)**

OR

2 a. Explain the models of mechanical systems. **(06 Marks)**

b. With a neat block diagram, explain the working of automatic electric iron. **(06 Marks)**

c. Derive an expression for transfer function of armature controlled DC motor. **(08 Marks)**

Module-2

3 a. Explain the standard test inputs. **(08 Marks)**

b. Define order and type of a system. **(04 Marks)**

c. The response of a system subjected to a unit step input is $C(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$. Obtain the expression for the closed loop transfer function. Also determine the undamped natural frequency and damping ratio of the system. **(08 Marks)**

OR

4 a. Derive the relation for transient response of a second order system. **(10 Marks)**

b. For the control system shown in Fig. Q4 (b), find the percentage overshoot and settling time for a unit step input.

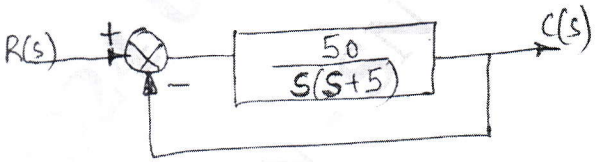

Fig. Q4 (b) **(10 Marks)**

Module-3

5 a. For the system shown in Fig. Q5 (a), determine closed loop transfer function.

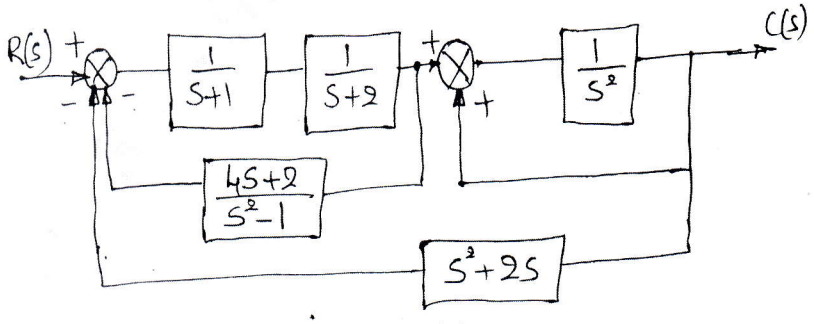

Fig. Q5 (a) **(10 Marks)**

b. Find the transfer function for the signal flow graph shown in Fig. Q5 (b), if $G_1 = 5$, $G_2 = G_4 = 10$, $G_3 = 1$, $G_5 = 2$, $H_1 = 1$, $H_2 = 2$, $H_3 = 0.5$ and $H_4 = 1$.

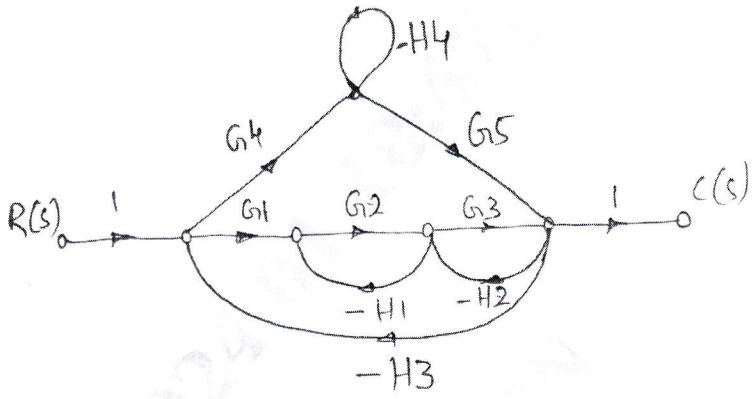

Fig. Q5 (b) **(10 Marks)**

OR

6 a. Draw the signal flow graph for the given block diagram shown in Fig. Q6 (a) and find its control ratio using Mason's gain formula.

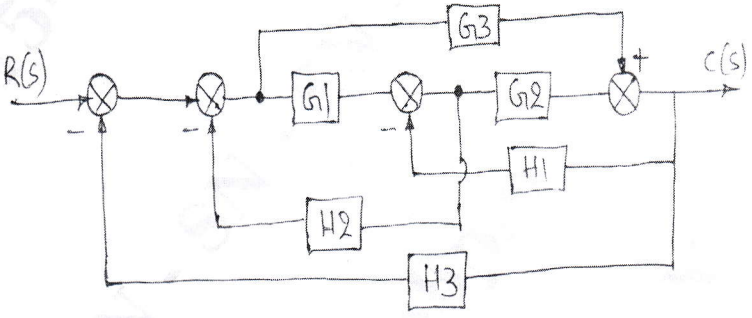

Fig. Q6 (a) **(10 Marks)**

b. Reduce the block diagram shown in Fig. Q6 (b) to its simplest possible form and find its closed loop transfer function.

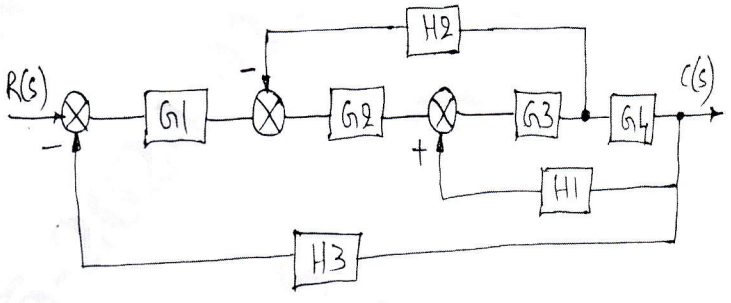

Fig. Q6 (b) **(10 Marks)**

Module-4

7 a. Comment on the stability of the system for the characteristic equation $s^5 + 4s^4 + 8s^3 + 8s^2 + 7s + 4 = 0$, by Routh-Hurwitz criterion. **(07 Marks)**

b. By applying RH criterion, discuss the stability of the closed loop system as a function of K for the following open loop transfer function,

$$G(s)H(s) = \frac{K(s+1)}{s(s-1)(s^2+4s+16)}$$ **(07 Marks)**

c. Explain break away point and break in point in root locus. **(06 Marks)**

OR

8 Construct a root locus for the open loop transfer function, $G(s)H(s) = \frac{k(s+2)}{s(s+1)(s+8)}$. **(20 Marks)**

Module-5

9 a. Sketch the Polar plot for the transfer function, $G(s) = \frac{10}{s(s+1)(s+2)}$. **(08 Marks)**

b. Using Nyquist criterion, investigate the stability of a system whose open loop transfer function is $G(s)H(s) = \frac{K}{(s+1)(s+2)(s+3)}$. **(12 Marks)**

OR

10 a. Explain gain margin and phase margin with sketches. **(04 Marks)**

b. Sketch the Bode plot for the transfer function,

$$G(s) = \frac{Ks^2}{(1+0.02s)(1+0.2s)}.$$

Determine the value of K, for the gain cross over frequency to be 5 rad/sec. **(16 Marks)**

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