USN

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Control Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Draw neat sketches wherever necessary.

Module-1

1 a. Define open loop system and discuss its advantages and disadvantages. **(05 Marks)**

b. Explain the requirements of an ideal control system (at least five). **(05 Marks)**

c. Explain the following controllers, (i) PI controller (ii) PID controller. **(10 Marks)**

OR

2 a. What are the key elements used in the mathematical modeling of mechanical system? **(04 Marks)**

b. Explain the steps to solve problems on analogous systems. **(06 Marks)**

c. Draw the equivalent mechanical system of the given system shown in Fig. Q2 (c). **(10 Marks)**

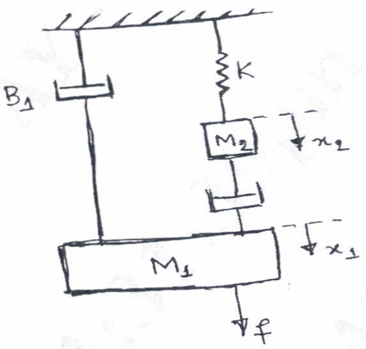

Fig. Q2 (c)

Module-2

3 a. With neat sketches, explain standard test signals in control system. **(10 Marks)**

b. A unity feedback system has, $G(s) = \dfrac{40(s+2)}{s(s+1)(s+4)}$. Determine (i) Type of system, (ii) All error coefficients (iii) Error for ramp input with magnitude 4. **(10 Marks)**

OR

4 a. With a neat sketch of transient response specifications, explain, (i) Delay time (ii) Rise time (iii) Peak time (iv) Peak overshoot (v) Settling time. **(10 Marks)**

b. A unity feedback system is characterized by open loop transfer function, $G(s) = \dfrac{10}{s^2+2s+6}$

Determine the following when the system is subjected to unit step input :

(i) Undamped natural frequency.
(ii) Damping ratio.
(iii) Peak overshoot
(iv) Peak time
(v) Settling time **(10 Marks)**

Module-3

5 a. What is block diagram? With neat sketches, explain the following rules of block diagram reduction technique :

(i) Reducing blocks in series (ii) Reducing blocks in parallel

(iii) Merging of two summing point (iv) Moving a summing point behind the block.

(10 Marks)

b. Reduce the block diagram and obtain its transfer function $\frac{C(s)}{R(s)}$. Block diagram shown in Fig. Q5 (b).

(10 Marks)

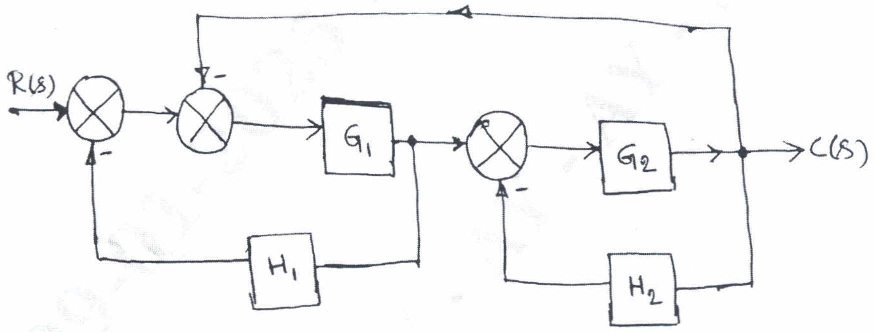

Fig. Q5 (b)

OR

6 a. For the system shown in Fig. Q6 (a), determine $\frac{C(s)}{R(s)}$ using Mason's gain formula.

(10 Marks)

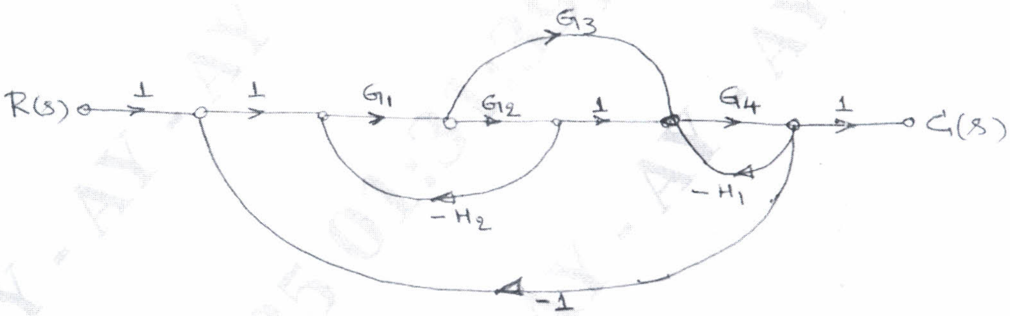

Fig. Q6 (a)

b. Find $\frac{C(s)}{R(s)}$ for the following system shown in Fig. Q6 (b). Use Mason's gain formula.

(10 Marks)

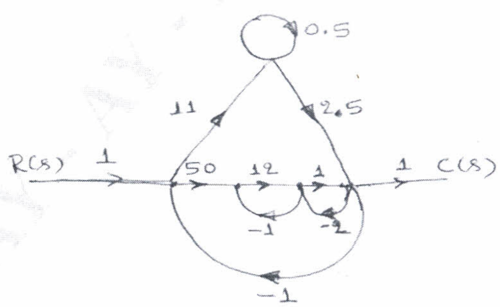

Fig. Q6 (b)

Module-4

7 a. Investigate the stability of system using Routh Hurwitz criterion having characteristics equation, $s^5 + 4s^4 + 12s^3 + 20s^2 + 30s + 100 = 0$. **(10 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 :

$$G(s)H(s) = \frac{K(s+1)}{s(s-1)(s^2+4s+16)}.$$ **(10 Marks)**

OR

8 Sketch the root locus of the system whose open loop transfer function is given by,

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

Also comment on the stability of the system. **(20 Marks)**

Module-5

9 a. Explain the steps to solve problems by Nyquist criterion. **(04 Marks)**

b. Draw Nyquist plot for $G(s)H(s) = \dfrac{K}{s(s+2)(s+10)}$. Also calculate the range of values of K for stability. **(16 Marks)**

OR

10 Sketch the Bode plot for a system having $G(s)H(s) = \dfrac{100}{s(s+1)(s+2)}$.

From the plot determine, (i) Gain margin (ii) Phase margin (iii) Gain cross over frequency (iv) Phase cross over frequency.

Comment on the stability of the system. **(20 Marks)**

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