Printed Page:-05 **Subject Code:- AEC0501**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B. Tech

SEM: V - THEORY EXAMINATION (2024-2025)

Subject: Control System

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. The disadvantage of Open loop system. (CO1,K1) 1

(a) They are inaccurate.
(b) They are unreliable.
(c) Any change in output cannot be corrected automatically.
(d) All of the above

1-b. A signal flow graph is used to find _____. (CO1,K1) 1

(a) Overall gain of the system
(b) Controllability of the system
(c) Poles of the system
(d) None of above

1-c. The final value theorem is used to find the (CO2,K1) 1

(a) Steady state value of the system output
(b) Initial value of the system output
(c) Transient behavior of the system output
(d) None of these

1-d. On which factor does the steady state error of the system depend? (CO2,K1) 1

(a) Order
(b) Type
(c) Size

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(d) Prototype

1-e. The bode plot is obtained using… (CO3,K1) 1

(a) Open loop poles
(b) Open loop zeros
(c) Breakaway points
(d) Break in points

1-f. The lag compensation has a… (CO3,K1) 1

(a) Zero nearer to the origin
(b) Pole nearer to the origin
(c) Pole at the origin
(d) Zero at origin

1-g. The minimum number of states require to describe the two degree differential equation: (CO4,K1) 1

(a) 1
(b) 2
(c) 3
(d) 4

1-h. Which among the following is a unique model of a system? (CO4,K1) 1

(a) Transfer fuction
(b) State variable
(c) Block Diagram
(d) SFG

1-i. Transfer Functions of Closed-Loop Discrete-Data Systems will be equal to… (CO5,K1) 1

(a) G(z)/1+G(z)H(z)
(b) G(z)/1-G(z)H(z)
(c) /1+G(z)H(z)
(d) None of the above

1-j. Check the system stability of the given system function H(z)= 5z/(z-0.2)(z-0.8). (CO5,K1) 1

(a) Stable
(b) Unstable
(c) Mraginal stable
(d) None of the above

2. Attempt all parts:-

2.a. Define self-loop and feedback loop. (CO1,K2) 2

2.b. Draw the response of first-order system for unit impulse input. (CO2,K2) 2

2.c. Define Nyquist criteria to calculate the system stability. (CO3,K2) 2

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2.d. Difference between homogenous and non homogeneous state Equation. (CO4,K2) 2

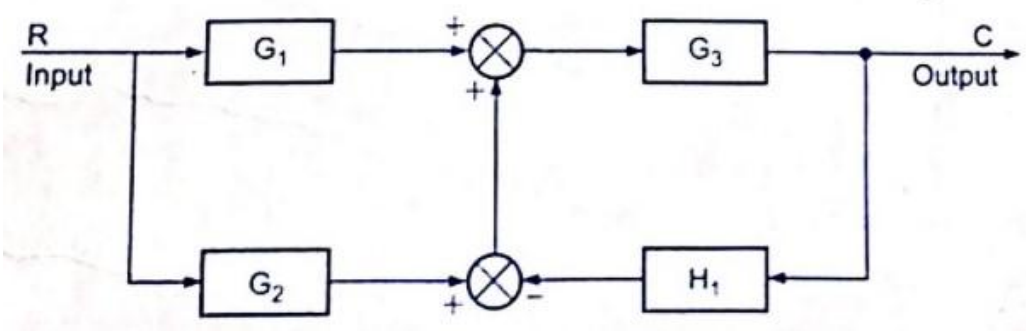
2.e. Write the mathematical equation of Zero-Order Hold. (CO5,K1) 2

SECTION-B 30

3. Answer any five of the following:-

3-a. What is feedback? Briefly Explain the effects of feedback on control system. (CO1,K2) 6

3-b. From the block diagram shown in the below figure, draw the corresponding SFG and evaluate close loop transfer function relating the output and input. (CO1,K3) 6



3-c. Define sensitivity with respect to forward path transfer function and feedback path transfer function. (CO2,K2) 6

3-d. Derive the expression for transfer function of PID controller with block diagram. (CO2,K3) 6

3.e. Find the frequency domain specification with a unity feedback system having G(s)=36/s(s+8). (CO3,K3) 6

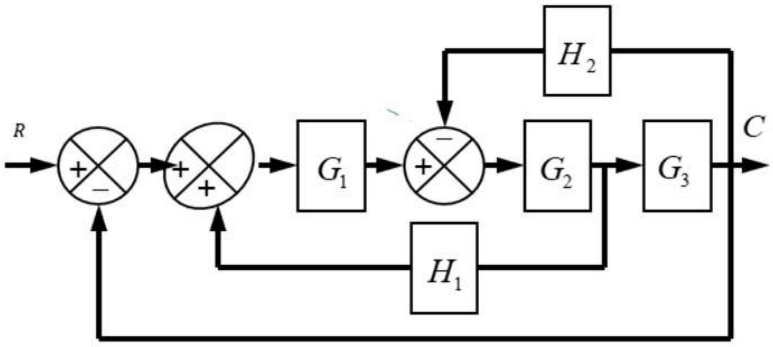
3.f. Define eigen value, eigen vector and characteristic equation. (CO4,K2) 6

3.g. Define Laplace transform. Write down the basic properties of Laplace transform. (CO5,K2) 6

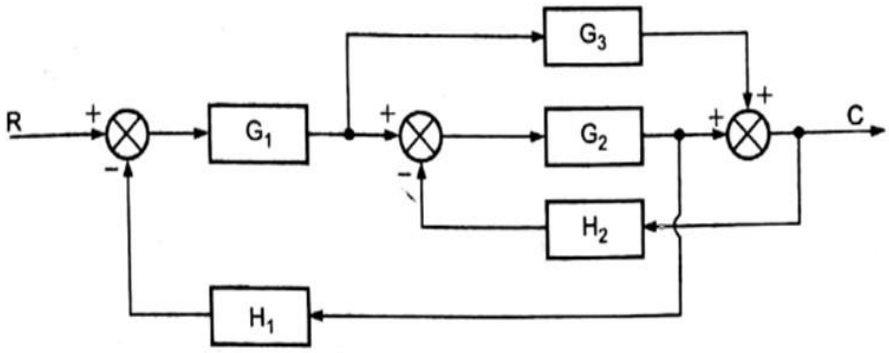
SECTION-C 50

4. Answer any one of the following:-

4-a. Find the overall transfer function C/R from the given block diagram using block diagram reduction technique. (CO1,K3) 10



4-b. Determine the overall transfer function C(s)/ R(s) of a given block diagram using SFG. (CO1,K3) 10



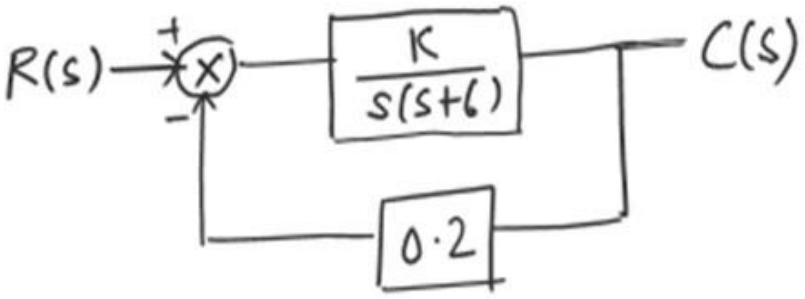
5. Answer any <u>one</u> of the following:-

5-a. The open loop transfer function of a control system is given below (CO2,K3) 10

$$G(s)H(s)=\frac{2(s^2+3s+20)}{s(s+2)(s^2+4s+10)}$$

Determine the static error coefficient and steady-state error for the input given as
(a) 5 (b) 4t (c) 4(t^2/2)

5-b. A closed-loop control system is shown in the figure. (CO2,K3) 10



The system is to have a damping ratio of 0.7. determine the value of K to satisfy this condition and calculate the settling time, peak time, and maximum overshoot for the value of K thus determined

6. Answer any <u>one</u> of the following:-

6-a. Determine the stability of a closed loop control system whose characteristic equation is. (CO3,K3) 10

$$s^6+ s^5 +5s^4+ 3s^3+2s^{2-} -4s^1 -8= 0$$

6-b. Sketch the bode plot of the system given by, (CO3,K3) 10

$$G(s)H(s) = \frac{k}{s(s+0.5)(s^2+0.6s+10)}$$

And determine the stability of the system.

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7. Answer any <u>one</u> of the following:-

7-a. Determine the transfer function matrix for the system given below and draw the block diagram. (CO4,K3) 10

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 3\\ -2 & -5\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1 & 1\\ 1 & 1\end{bmatrix} u(t) \quad \text{and } y = \begin{bmatrix}2 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}.$$

7-b. Verify the controllability for data given below: (CO4,K3) 10

$$\dot{x}_1 = x_2 + u_1$$
$$\dot{x}_2 = x_3$$
$$\dot{x}_3 = -2x_2 - 3x_3 + u_1 + u_2.$$

8. Answer any <u>one</u> of the following:-

8-a. Consider that a discrete-data system is described by the difference equation: $y(n+2)+ 5y(n+1) + 3y(n) = x(n+1) + 2x(n)$. Evaluate the transfer function of the system, the characteristic equation, and State variable matrices A and B. (CO5,K4) 10

8-b. Derive the expression for Steady-state error for the discrete data control system. Also derive the expression for the error coefficient. (CO5,K3) 10

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