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Printed Page:-5 **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 (2025 - 2026)
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. If the initial conditions for a system are zero. What does it physically mean? (CO1,K1) 1

(a) The system is at rest but stores energy
(b) The system is working but does not store energy.
(c) The system is at rest and no energy is stored.
(d) The system is working with zero reference input

1-b. Which of the following is an example of an open-loop system? (CO1,K2) 1

(a) Household Refrigerator
(b) Respiratory system of an animal
(c) Stabilization of air pressure entering the mask
(d) Execution of program by computer

1-c. When the damping ratio equal to zero, the damping frequency of a system will be? (CO2,K1) 1

(a) Equal to natural frequency
(b) Zero
(c) More than natural frequency
(d) Less than natural frequency

1-d. Standard test signals in the control system are... (CO2,K1) 1

(a) Impulse signal
(b) Ramp signal
(c) Unit step signal
(d) All of the mentioned

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1-e. When the number of poles equal to the number of zeros, how many branches of root locus tend towards infinity? (CO3,K1) 1

(a) 1
(b) 2
(c) 0
(d) None of above

1-f. Routh Hurwitz criterion gives…. (CO3,K1) 1

(a) Relative stability
(b) Absolute stability
(c) Gain margin
(d) phase margin

1-g. In state space analysis, matrix C is called the----- (CO4,K1) 1

(a) System matrix
(b) Input matrix
(c) Output matrix
(d) Data transmission matrix

1-h. The number of state variables of a system is equal to…(CO4,K2) 1

(a) Number of integrators present in the system
(b) Number of differentiators present in the system
(c) Sum of the number of integrators and differentiators present in the system
(d) None of the above

1-i. Find the Laplace transform of $\delta(t)$. (CO5,K1) 1

(a) 0
(b) 1
(c) infinity
(d) 2

1-j. In z-Transform, z is a _____. (CO5,K1) 1

(a) complex variable with real and imaginary parts.
(b) Rational number
(c) composite number
(d) None of above

2. Attempt all parts:-

2.a. What are the advantages of a closed loop control System? (CO1,K2) 2

2.b. What is transient response of a system? (CO2,K2) 2

2.c. Explain absolute stability and Relative stability with a suitable example. (CO3,K2) 2

2.d. Write the advantages of the state variable approach over the transfer function approach. (CO4,K2) 2

2.e. Difference between Discrete and Continuous time signal. (CO5,K2) 2

SECTION-B 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i)	What is SFG? Discuss the essential characteristics of Signal Flow Graphs? (CO1,K3)	6
3.a.(ii)	Define the phenomenon of block diagram reduction? What are the advantages to represent a system in block diagram form? (CO1,K3)	6

3.b. Answer any one of the following:-

3.b.(i)	Derive the expressions and draw the response of first order system for unit ramp input with neat and clean diagram. (CO2,K3)	6
3.b.(ii)	Explain the following terms: undamping, over damping, critical damping & under damping with neat diagram. (CO2,K3)	6

3.c. Answer any one of the following:-

3.c.(i)	Find the breakaway point and number of root locus branches for the system whose open loop transfer function is G(s) = k/s(s+4). (CO3,K3)	6
3.c.(ii)	Explain the properties of the RH table. Briefly explain Routh Hurwitz's criterion for determining the stability of a control system. (CO3,K2)	6

3.d. Answer any one of the following:-

3.d.(i)	What are the need for a controllability test and observability test for a system to be optimal? (CO4,K2)	6
3.d.(ii)	What is state transition matrix? Enlist the properties of state transition matrix. (CO4,K2)	6

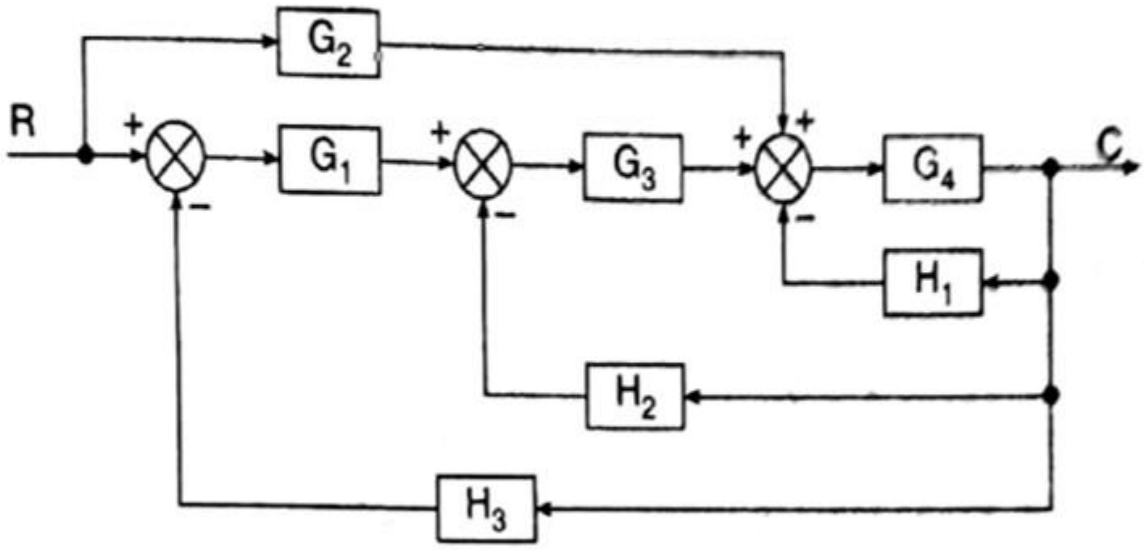
3.e. Answer any one of the following:-

3.e.(i)	Discuss Sample and Hold Devices with circuit diagram in detail. (CO5,K2)	6
3.e.(ii)	Briefly explains the process to convert a continuous time signal into a discrete time signal with suitable example. (CO5,K3)	6

SECTION-C 50

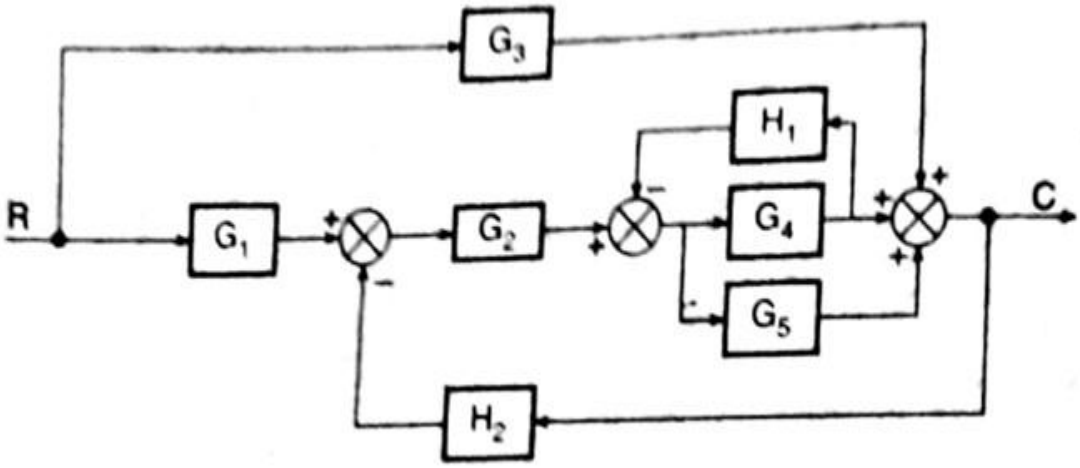
4. Answer any one of the following:-

4-a.	Reduce the block diagram show in figure using block diagram algebra and obtain system transfer function C/R. (CO1,K4)	10



4-b.	Draw the signal flow graph and detrmine the overall transfer function using	10

mason's gain formula. (CO1,K4)



5. Answer any one of the following:-

5-a. The open loop transfer function of unity feedback system is G(s) = 25/s(s+5) .Find (i) Natural frequency of oscillation (ii) damping frequency of oscillation (iii) Damping ratio (iv) Maximum overshoot of unit step input. (CO2,K4) 10

5-b. 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)

6. Answer any one of the following:-

6-a. Determine the stability of a closed loop control system whose characteristic equation is (CO3,K4) 10

$$s^5+s^4+2s^3+2s^2+11s^1+10=0$$

6-b. Sketch the root locus plot for the system having an open loop transfer function is given by. (CO3,K4) 10

$$G(s)\,H(s)=K/s(s+1)(s^2+4s+13)$$

7. Answer any one of the following:-

7-a. Obtain the state equation for the differential equation given below: (CO4,K3) 10

$$\frac{d^2y}{dt^2}+\frac{3dy}{dt}+4y=\frac{du}{dt}+3u\,.$$

7-b. Check for controllability and observability of a system having the following coefficient matrices. (CO4,K4) 10

$$\mathbf{A}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix},\ \mathbf{B}=\begin{bmatrix}1\\0\\1\end{bmatrix}\quad and\quad \mathbf{C}^T=\begin{bmatrix}10\\5\\1\end{bmatrix}.$$

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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.	What is the need of Z transformation? Define Z-transform with ROC? Write down the basic properties of Z transform. (CO5,K3)	10