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. Loop in which originating and termination point is same are known as-- (CO1,K1) 1

(a) feedback loop
(b) Non touching loop
(c) Self loop
(d) Feedback gain

1-b. In field-controlled DC motor… (CO1,K1) 1

(a) Armature voltage is kept constant, and the speed is varied by varying the flux of the machine(Field voltage)
(b) Field voltage is kept constant, and the speed is varied by varying the flux of the machine(armature voltage)
(c) Both varying voltage
(d) None of above

1-c. A good control system should be sensitive to-- (CO2,K1) 1

(a) Internal disturbances
(b) Environmental parameters
(c) Parametric variations
(d) Input signals (except noise)

1-d. Steady-state error is usually specified in terms of--- (CO2,K1) 1

(a) Error constants
(b) Damping factor
(c) Speed of response
(d) Bandwidth

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 lead compensation network is considered as…. (CO3,K1) 1

(a) High pass filter
(b) Low pass filter
(c) Equalizer
(d) None of these

1-g. The analysis of multiple input multiple output is conveniently studied by… (CO4,K1) 1

(a) State space analysis
(b) Root locus approac
(c) Characteristic equation approach
(d) Nicholas chart

1-h. The state equation in the phase canonical form can be obtained from the transfer function by-- (CO4,K1) 1

(a) Cascaded decomposition
(b) Parallel decomposition
(c) Direct decomposition
(d) None of the above

1-i. The relation between Laplace transforms and Z transform is _____form. (CO5,K1) 1

(a) Exponential
(b) Sinusoidal
(c) Linear
(d) None of the above

1-j. Convolution of time-signals is _____ in Z-transform. (CO5,K1) 1

(a) Addition
(b) Subtraction
(c) Multiplication
(d) Division

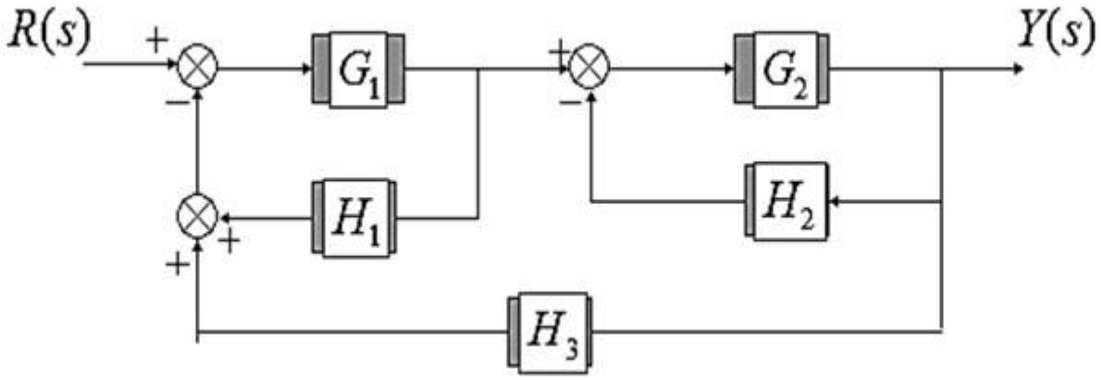
2. Attempt all parts:-

2.a.	Differentiate between stable, unstable, and marginally stable system. (CO1,K2)	2
2.b.	Draw the block diagram of PID controller. (CO2,K1)	2
2.c.	Define Gain margin and phase margin. (CO3,K2)	2
2.d.	Write the advantages of the state variable approach over the transfer function approach. (CO4,K1)	2
2.e.	Difference between Discrete and Continuous time signal. (CO5,K1)	2

SECTION-B 30

3. Answer any five of the following:-

3-a. Find the transfer function of the following block diagram. (CO1,K3) 6



3-b. The impulse response of a unity feedback control system is given below, (CO1,K3) 6

$c(t) = -t\,e^{-t} + 2\,e^{-t}$

Find the open loop transfer function.

3-c. What is the effect of adding a pole and zero to the forward path transfer function? (CO2,K2) 6

3-d. Draw the diagram of an underdamped system and define first undershoot, settling time and maximum overshoot. (CO2,K2) 6

3.e. Define the Nyquist criterion for finding the relative stability of a control system. Also, write the difference between the polar plot and the Nyquist plot. (CO3,K2) 6

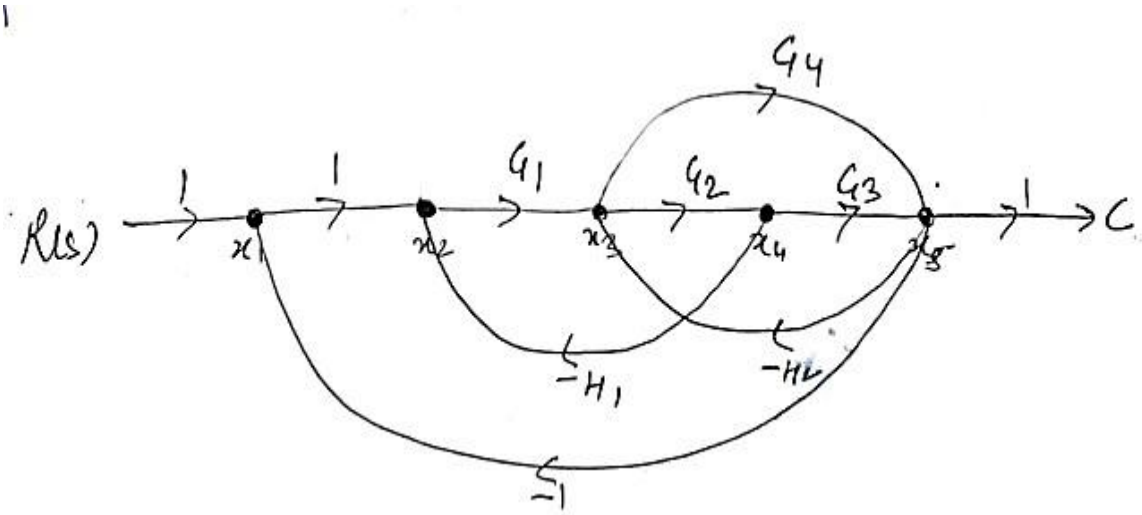
3.f. Define Kalman's test for controllability and observability. (CO4,K2) 6

3.g. Derive the expression for the solution of state equation for discrete data control system. (CO5,K3) 6

SECTION-C 50

4. Answer any one of the following:-

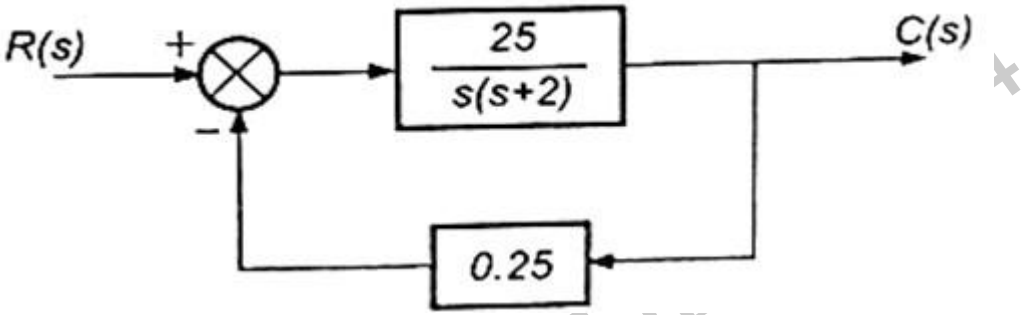
4-a. Find the transfer function of given SFG using Mason's Gain formula. (CO1,K3) 10



4-b. What is a servo motor? Derive the transfer function of armature-controlled DC servo motor with suitable diagram. (CO1,K3) 10

5. Answer any one of the following:-

5-a. Determine the sensitivity of the overall closed-loop transfer function for the system shown in the figure at $\omega=1$ rad/s with respect to (a) forward path transfer function (b) feedback path transfer function. (CO2,K3) 10



5-b. The overall transfer function of a control system is given by (CO2,K3) 10

$$\frac{C(s)}{R(s)} = \frac{16}{s^2 + 1.6s + 16}$$

It is desired that the damping ratio is 0.8. determine the derivative rate feedback constant K_t and compare rise time, peak time, maximum overshoot, and steady-state error for unit ramp input without and with derivative feedback control.

6. Answer any one of the following:-

6-a. Sketch the root locus of the system whose open loop transfer function is G(s) = K/s(s+4). Find the value of K, if the damping ratio is to be 0.707. (CO3,K3) 10

6-b. Sketch the bode plot for the system with TF, 10

$$G(s)H(s)=1000/(1+0.1s)(1+0.001s)$$

Determine Gain Margin, Phase margin, and system stability. (CO3,K3)

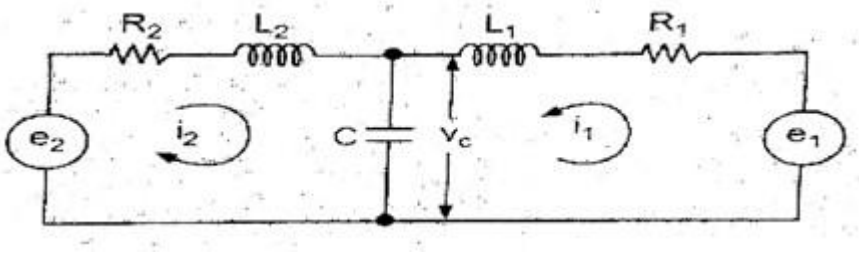
7. Answer any <u>one</u> of the following:-

7-a. Construct the state model for a system characterized by a differential equation, (CO4,K3) 10

$$\frac{d^3y}{dt^3} = 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y = u$$

Obtain a block diagram and signal flow graph representation of the state model.

7-b. Determine the state model for the electrical circuit shown in the below figure. (CO4,K4) 10



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

8-a. Describe the Block diagram of a closed-loop discrete data control system. Also derive the expression for the transfer function of the closed-loop discrete data control system. (CO5,K3) 10

8-b. Determine the pulse transfer function and stability of sampled data control system shown in the below figure for sampling time (a) T=0.5 sec (b) T=1 sec. (CO5,K3) 10