Printed Page:- 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 (2022 - 2023)

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. When a human being tries to approach an object, his brain acts as? (CO1) 1

(a) An error measuring device

(b) A controller

(c) An actuator

(d) An amplifier

1-b. The relationship between an input and output variable of a signal flow graph is given by the net gain between the input and output node is known as the (CO1) 1

(a) Multiplication of two gain

(b) Overall gain of the system

(c) Division of two gain

(d) None of above

1-c. For the second-order control system, if the damping ratio is 1 then the poles are... (CO2) 1

(a) Imaginary & complex conjugate

(b) In the right half of s-plane

(c) Equal, negative, and real

(d) Negative and real

1-d. The input of a controller is (CO2) 1

(a) Sensed signal

(b) Error signal

(c) Desired variable value

(d) Signal of fixed amplitude not dependent on desired variable value

1-e. The Routh-Hurwitz criterion cannot be applied when the characteristic equation of the system contains any coefficients which is (CO3) 1

(a) negative real and exponential functions of s

(b) Negative real, both exponential and sinusoidal functions of s

(c) Both exponential and sinusoidal functions of s.

(d) Complex, both exponential and sinusoidal functions of s

1-f. The lead compensation network is considered as…. (CO3) 1

(a) High pass filter

(b) Low pass filter

(c) Equalizer

(d) None of these

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

(a) System matrix

(b) Input matrix

(c) Output matrix

(d) Data transmission matrix

1-h. Which among the following plays a crucial role in determining the state of dynamic system? (CO4) 1

(a) State variables

(b) State vector

(c) State space

(d) None of these

1-i. The ‘s’ operator in Laplace transform is given by…. (CO5) 1

(a) $\sigma + j\Omega$

(b) σ -jΩ

(c) σ *jΩ

(d) None of the above

1-j. Steady-state error for type 2 system for discrete data control system subjected to a unit parabolic input… (CO5) 1

(a) R/K

(b) 0

(c) 1

(d) None of above

2. Attempt all parts:-

2.a. What is Servomechanism? (CO1) 2

2.b. Draw the response of second order system with unit step input for underdamped condition. (CO2) 2

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

2.d. Explain the limitations of classical theory of system analysis. (CO4) 2

2.e. Define BIBO Stability related to discrete data systems. (CO5) 2

SECTION B 30

3. Answer any five of the following:-

3-a. What do you mean by analogous system? Explain Force-Voltage analogy with suitable example. (CO1) 6

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

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

Find the open loop transfer function. (CO1)

3-c. Define the following terms with expression: Damping factor (b) damped frequency (c) natural frequency. (CO2) 6

3-d. What are the advantages and disadvantages of PD, PI and PID controller? (CO2) 6

3.e. What are the minimum and non-minimum phase systems? Draw the poles and the Impulse response of stable, Unstable, and Marginal systems in the s-plane. (CO3) 6

3.f. What is an state transition matrix? The state equation of an LTI control system is given below, Find out the state transition matrix. (CO4) 6

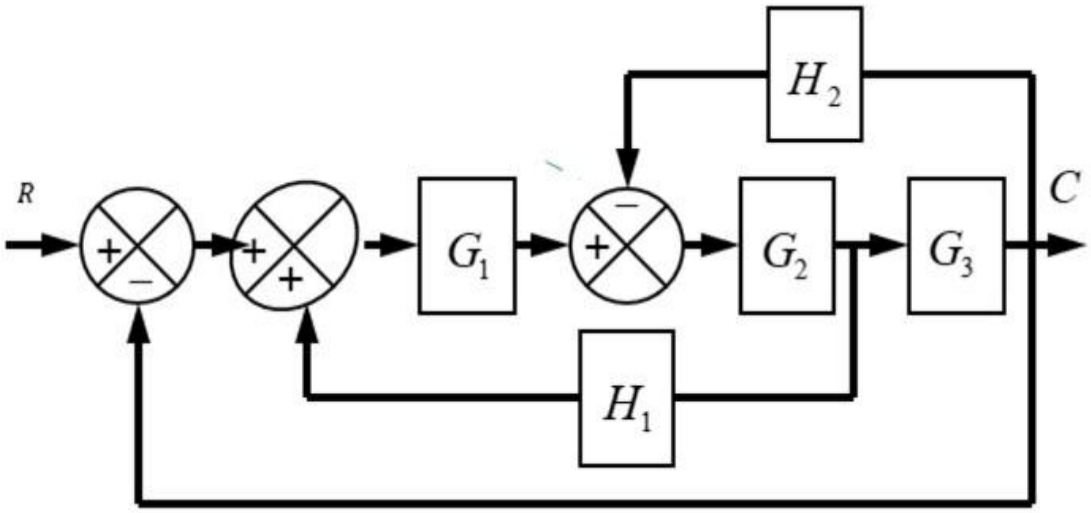
$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 2 \\ -2 & 0 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}\mathbf{u}$$

3.g. What is steady state error in the discrete data control system? Briefly explain steady-state error analysis of discrete data control system due to step function output. (CO5) 6

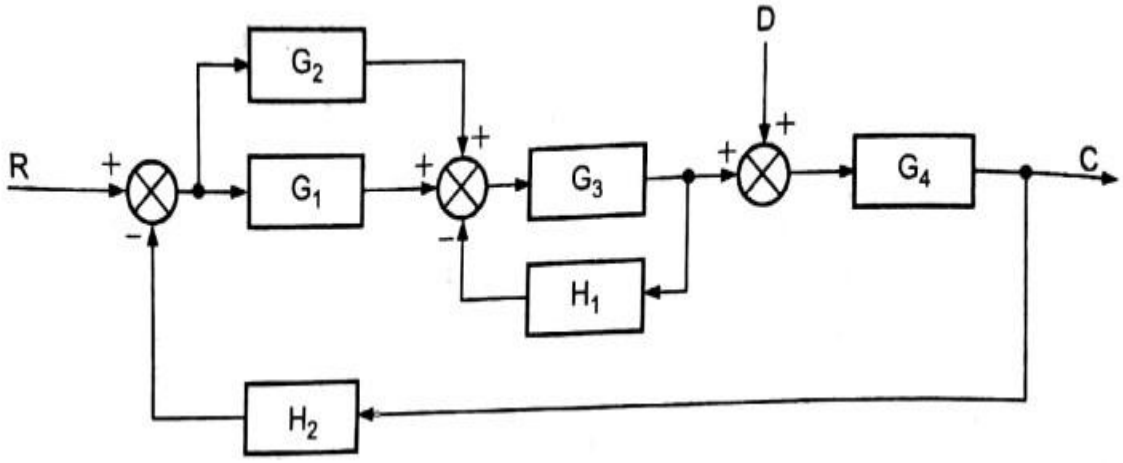
SECTION C 50

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) 10



4-b. Determine the overall output C(s) of a given block diagram using SFG. (CO1) 10



5. Answer any one of the following:-

5-a. Derive the expression for rise time, maximum overshoot & peak time of second order system subjected to unit step input. (CO2) 10

5-b. The maximum overshoot for unity feedback control system having its forward path transfer function G(s) =K/s (sT+1) is to be reduced by 60% to 20%. The system input is unit step function. Determine the factor by which K reduced to achieve aforesaid reduction. (CO2) 10

6. Answer any one of the following:-

6-a. The open loop transfer function of a control system is given by (CO3) 10

$$G(s)\,H(s) = \frac{K}{s\,(s+6)\,(s^2+4s+13)}$$

Sketch the root locus and determine system stability.

6-b. The open loop transfer function of a system is (CO3) 10

$$G(s)H(s) = \frac{k(s+1)}{s^3+bs^2+3s+1)}$$

Determine the values of K and b so that system will oscillate at a frequency of 2 rad/sec by using R-H criteria

7. Answer any one of the following:-

7-a. Determine the transfer function matrix from the data given below: (CO4) 10

$$\mathbf{A} = \begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 1 \\ 1 \end{bmatrix},$$

$$C=[1\ 1],\ D=0$$

7-b. The transfer function of a control system is given by (CO4) 10

$$\frac{Y(s)}{U(s)} = \frac{s+2}{s^3+9s^2+26s+24}$$

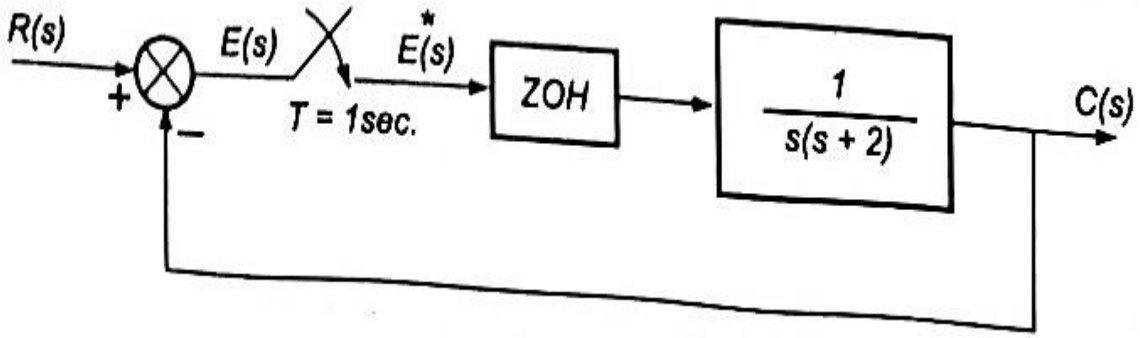
Check for controllability and observability.

8. Answer any one of the following:-

8-a. Find the inverse Z transform of the function given below using the partial fraction and power series method.(Assuming T=1sec) (CO5) 10

$$F(z) = \frac{0.632z}{z^2-1.368z+0.368}$$

8-b. Compute the pulse transfer function for the system using the sample and hold unit shown in the below figure: (CO5) 10


R(s)
+
−
E(s)
T = 1sec.
E*(s)
ZOH
1
s(s + 2)
C(s)