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 - CARRY OVER THEORY EXAMINATION - APRIL 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. For the open control system which of the following statements is incorrect? (CO1) 1

(a) Less expensive

(b) Recalibration is not required for maintaining the required quality of the output

(c) Construction is simple and maintenance easy

(d) Errors are caused by disturbances

1-b. The control Ratio or Overall transfer Function or Closed loop transfer function of a given control system **with positive feedback** will be (CO1) 1

(a) G(s)/1-G(s)H(s)

(b) G(s)/1+G(s)H(s)

(c) 1/1-G(s)H(s)

(d) None of above

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

(a) Equal to natural frequency

(b) Zero

(c) More than natural frequency

(d) Less than natural frequency

1-d. In closed-loop control system, what is the sensitivity of the gain of the overall system M to the variation in G? (CO2) 1

(a) 1/ (1+G(s).H(s))

(b) 1/ (1+G(s))

(c) -G(s)H(s)/ (1+G(s).H(s))

(d) G(s)/ (1+G(s))

1-e. The number of individual loci in root locus plot is equal to _____. (CO3) 1

(a) The number of open loop poles

(b) The number of open loop zeros.

(c) The difference between the number of open loop poles and the number of open loop zeros.

(d) The number of open loop poles or zeros whichever is greater

1-f. A system with GM is close to unity or a PM close to zero ... (CO3) 1

(a) Relatively stable

(b) Oscillatory

(c) Stable

(d) none of above

1-g. Using state variables, an nth – order differential equation can be decomposed into : (CO4) 1

(a) n number of first – order differential equations

(b) n/2 number of first – order differential equations

(c) unlimited number of first – order differential equations

(d) None of the above

1-h. The analysis of multiple input multiple output is conveniently studied by... (CO4) 1

(a) State space analysis

(b) Root locus approac

(c) Characteristic equation approach

(d) Nicholas chart

1-i. Convolution of time-signals is _____ in Z-transform. (CO5) 1

(a) Addition

(b) Subtraction

(c) Multiplication

(d) Division

1-j. Zero input stability of discrete data system requires that..... (CO5) 1

(a) The roots of the characteristic equation lie inside the unit circle in z-plane

(b) The roots of the characteristic equation lie outside the unit circle in z-plane

(c) The roots of the characteristic equation lie on the unit circle in z-plane

(d) None of above

2. Attempt all parts:-

2.a. Define type and order of a given transfer function. (CO1) 2

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

2.c. Differentiate between the Polar plot and the Nyquist plot. (CO3) 2

2.d. Explain Bush Form of resultant matrix A in direct form decomposition. (CO4) 2

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

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. Define the phenomenon of block diagram reduction? What are the advantages to represent a system in block diagram form? (CO1) 6

3-b. Find OLTF loop DC gain of a unity feedback system having CLTF is (CO1) 6
$(2S + 5) / (S^2 + 6S + 13)$

3-c. Define time response of a control system? Derive the expressions and draw the response of first order system for unit impulse input. (CO2) 6

3-d. Illustrate the main differences between PD ,PI and PID controller. (CO2) 6

3.e. Draw the root locus for the system whose open loop transfer function is G(s) = k/s(s+4). (CO3) 6

3.f. Briefly explain the procedure of converting a differential equation in to a state model. (CO4) 6

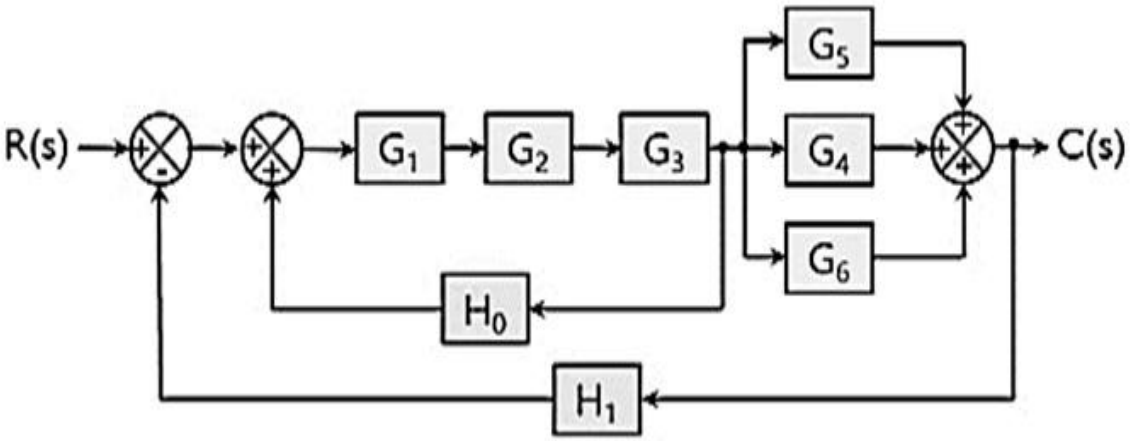
3.g. Consider the following system: y(n)= 0.5y(n-1) +0.4x(n) -0.3x(n-1), Calculate H(z)=Y(z)/X(z) of above system. (CO5) 6

SECTION C **50**

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

4-a. What is BDR technique? Find the overall transfer function from the given block 10

diagram using block diagram reduction technique. (CO1)



4-b. Briefly Explain the basic operational principle of the DC servo motor with a suitable example. Also Derive the expression for the transfer function of the Field-controlled DC servo motor with a suitable diagram. (CO1) 10

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

5-a. Derive the expression and draw the response of second order system for critically damped case and when input is unit step. (CO2) 10

5-b. Define time response of a given system. Derive and draw the response of first order system subjected to (a) unit impulse input (b) unit step input (c) unit ramp input (CO2) 10

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

6-a. Using Routh Hurwitz criterion determine the relationship between K and T so that the unity feedback control system whose open loop transfer function given below is stable. (CO3) 10

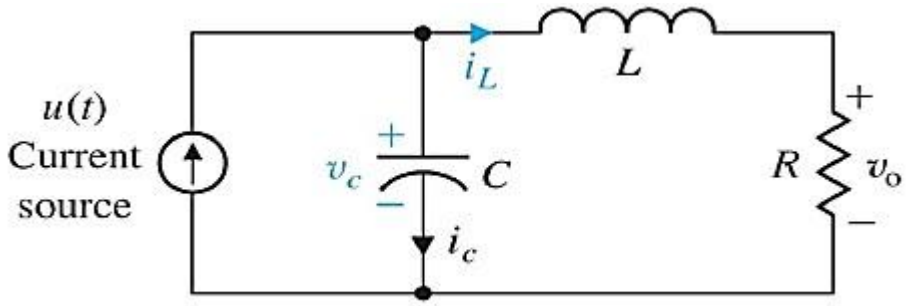
$$G(s) = \frac{K}{S[S(S+10)+T]}$$

6-b. Constructs bode plot for the system whose open loop transfer function is given below and determine (a) GM (b) PM (c) System stability.(CO3) 10

$$G(S) = \frac{4}{s(1+0.5s)(1+0.08s)}$$

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

7-a. Derive the dynamic equation for the electric circuit shown in the below figure. (CO4) 10



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

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

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

8-a. Briefly explain the initial and final value theorem for s domain and z domain. (CO5) 10

8-b. Define the Pulse transfer function when two blocks are connected in cascade using a sampler in the input. Also, Determine the Z transform of output for the sampled data system shown in the below figure, considering the input function to be a unit step. (CO5) 10