

Q.6 Attempt any two:

- i. A dynamic system is represented by the state equation.
- 5

$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} r$$

Check whether the system is completely controllable.

- ii. What is transfer matrix of a control system? Derive the equation for transfer matrix. 5
- iii. Obtain the state model for the given transfer function 5

$$\frac{Y(s)}{U(s)} = \frac{1}{s^2 + s + 1}$$

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Total No. of Questions: 6

Total No. of Printed Pages: 4

Enrollment No.....



Faculty of Engineering  
End Sem Examination May-2023

EC3CO09 Control Systems

Programme: B.Tech.

Branch/Specialisation: EC

**Duration: 3 Hrs.****Maximum Marks: 60**

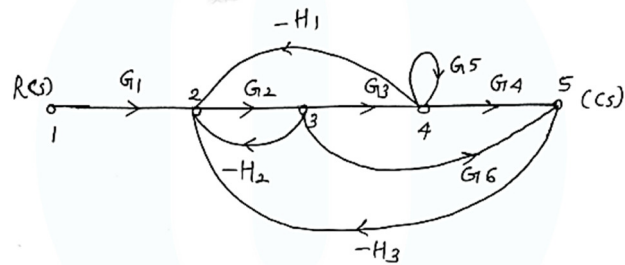
Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

- Q.1 i. A control system working under unknown random actions is called 1  
\_\_\_\_\_.
- (a) Adaptive control system (b) Stochastic control system  
(c) Computer control system (d) Digital data system
- ii. Which of the following statements is correct for any closed loop 1  
system?
- (a) Only one of the static error co-efficient has a finite non-zero value  
(b) All the co-efficient can have zero value  
(c) All the co-efficient are always non-zero  
(d) All of these
- iii. In a stable control system backlash can cause which of the following: 1
- (a) Overdamping  
(b) Low-level oscillations  
(c) Underdamping  
(d) Poor stability at reduced values of open loop gain
- iv. Which of the following control systems have non-repeatable & 1  
unpredictable?
- (a) Stochastic control systems (b) Deterministic control systems  
(c) Open loop control systems (d) Dynamic control systems
- v. As the polar plot moves toward the point (-1, 0) then the system 1  
becomes-
- (a) Stable (b) Marginally stable  
(c) Conditionally stable (d) Unstable

P.T.O.

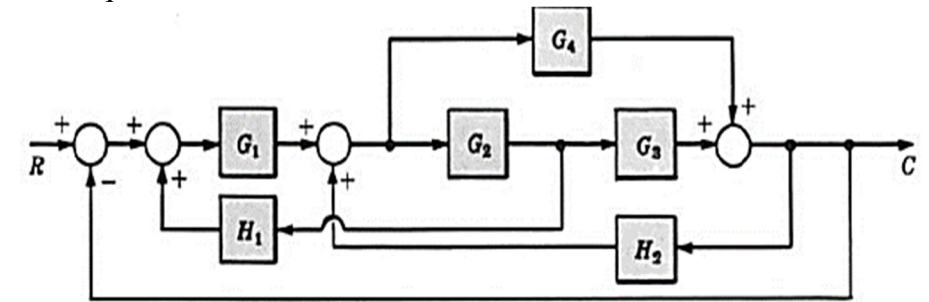
[2]

- vi. The concepts used to measure relative stability are- **1**  
 (a) Phase margin (b) Gain margin  
 (c) Phase and Gain margin (d) Stable
- vii. Which of the following should be done to make an unstable system stable? **1**  
 (a) The gain of the system should be decreased  
 (b) The gain of the system should be increased  
 (c) The number of poles to the loop transfer function should be increased  
 (d) The number of zeros to the loop transfer function should be increased
- viii. A controller, essentially, is a- **1**  
 (a) Sensor (b) Clipper (c) Comparator (d) Amplifier
- ix. State variable analysis has several advantages overall transfer function as- **1**  
 (a) It is applicable for linear and non-linear and variant and time-invariant system  
 (b) Analysis of MIMO system  
 (c) It takes initial conditions of the system into account  
 (d) All of these
- x. The minimum number of states require to describe the two-degree differential equation- **1**  
 (a) 1 (b) 2 (c) 3 (d) 4
- Q.2 i. Classify the following as open or closed loop system with valid reasons **2**  
 (a) An electrical On-Off switch  
 (b) Room air-conditioner.
- ii. Draw the signal flow graph for the following sets of algebraic equations. **3**  
 $x_1 = ax_0 + bx_1 + cx_2$ ,  $x_2 = dx_1 + ex_3$ ,  $x_3 = fx_0 + gx_2$ ,  $x_4 = hx_3$
- iii. Find the transfer function using Mason's gain equation- **5**



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- OR iv. Find the transfer function of the given system using block reduction technique **5**



- Q.3 i. What are the standard test signals used in control systems? **2**  
 ii. A unity feedback control system has an open loop transfer function- **8**  
 $G(s) = K(s+9)/s(s+3)(s+5)$   
 Sketch the root locus.
- OR iii. What is meant by transient response and steady state response? Explain **8**  
 in detail about various time domain specifications.
- Q.4 i. What are frequency domain specifications? Define any three. **3**  
 ii. Draw the Nyquist plot for the system whose open loop transfer function is- **7**

$$G(s)H(s) = \frac{K}{s(s+2)(s+10)}$$

- Determine the range of K for which the closed loop system is stable.
- OR iii. Plot the Bode diagram for the following transfer function and find the **7**  
 Gain margin and Phase margin.  
 $G(S) = 10/S(1+0.4S)(1+0.1S)$
- Q.5 i. Compare PI, PD and PID controllers. **4**  
 ii. Describe the design procedure of a lag compensator. **6**
- OR iii. The open loop transfer function of certain unity feedback control system is given by- **6**

$$G(s) = \frac{K}{s(s+4)(s+80)}$$

It is desired to have the phase margin to be at least  $33^\circ$  and the velocity error constant  $K_v = 30$  per sec. Design a phase lag series compensator

P.T.O.

*Marking Scheme*  
*Control System (EC3CO09)*  
*Many-June-2023*

**Q.1**

One marks for each correct answer of objectives

- i. (b) Stochastic control system
- ii. (c) All the co-efficient are always non-zero
- iii. (b) Low-Level Oscillations
- iv. (a) Stochastic control system
- v. (d) Unstable
- vi. (c) Phase and Gain Margin
- vii. (d) the no of zeros of the loop transfer function should be increased
- viii. (c) Comparator
- ix. (d) All of the these
- x. (b) 2

**Q.2**

- i. one marks for each classification
- ii. Two marks for step and one mark for correct answer
- iii. Formula one marks, two marks for step and two marks for correct answer.

**Q.3**

- i. Three marks for step and two marks for correct answer
- ii. Half marks for each name
- iii. One marks for pole zero plot, one mark for centroid, one marks for angle of asymptotes, two marks for break away point, one marks for intersection with imaginary axis, two marks for plot.
- iv. Two marks for each specifications.

**Q.4**

- i. One marks for Each Specifications
- ii. Two marks for step, three marks for plot, two marks for value of K.
- iii. One marks for corner frequency, Four marks for Plot and calculations, Two marks for GM and PM.

**Q.5**

- i. One marks for One comparison
- ii. One marks for one procedure step
- iii. Three marks for step and three marks for correct answer

**Q.6**

- i. Three marks for controllability matrix and two marks for correct answer.
- ii. Three marks for step and two marks for correct answer.
- iii. Three marks for step and two marks for correct answer