

Register No.: ..... Name: .....

**SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)**

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**FIFTH SEMESTER B.TECH DEGREE EXAMINATION (Regular), DECEMBER 2022****ROBOTICS AND AUTOMATION****(2020 SCHEME)****Course Code: 20RBT307****Course Name: Control Systems****Max. Marks: 100****Duration: 3 Hours****PART A***(Answer all questions. Each question carries 3 marks)*

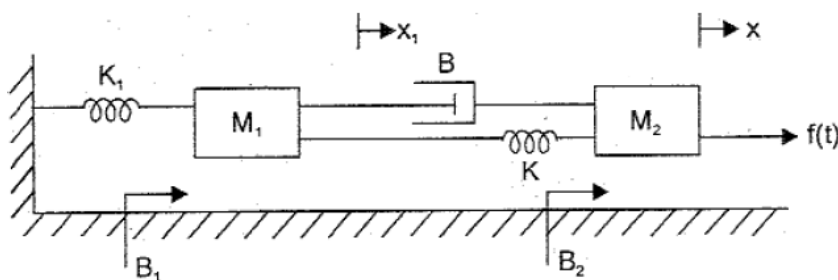
1. Differentiate between open loop and closed loop systems.
2. Distinguish between order and type of a system
3. What is the criterion on the roots of the characteristics equation for the stability? How it is connected to BIBO stability?
4. Write any three properties of state transition matrix.
5. What are the characteristics of non linear control system?
6. Draw the signal flow graph for the following system.  

$$X_1 = ax_0 + bx_1 + cx_2$$

$$X_2 = dx_1 + ex_3$$
7. Draw the response of an undamped second order system with complex poles on the left half of S-plane showing rise time, peak overshoot and settling time.
8. Define gain margin and phase margin.
9. Give any two advantages of state space analysis.
10. What are the types of nonlinearities in control system?

**PART B***(Answer one full question from each module, each question carries 14marks)***MODULE I**

11. a) Determine the transfer function  $X(S)/F(S)$  for the system given below.



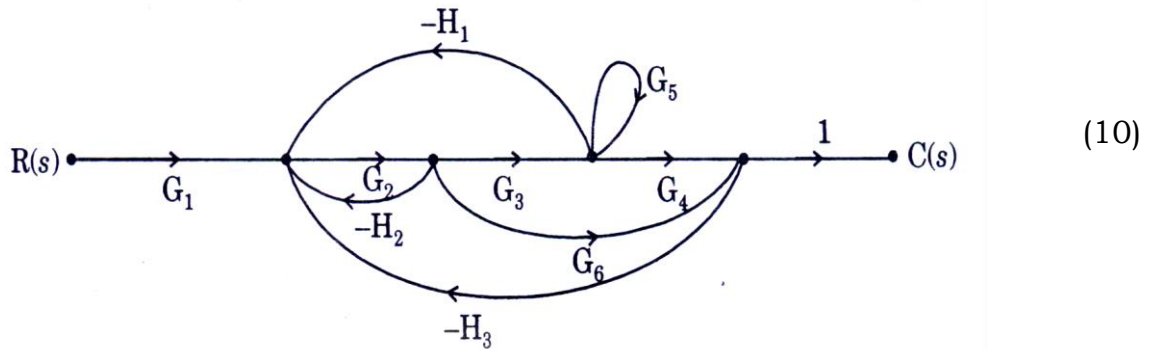
(10)

- b) Explain the components of a typical control system.

(4)

OR

12. a) Find the overall gain for the given signal flow graph. (10)



- b) Explain any two applications of closed loop control system. (4)

**MODULE II**

13. a) Explain time response of a second order system with unit step input. (7)  
 b) What is steady state error? Also explain static error coefficient. (7)

OR

14. a) Check the stability of the system whose characteristic equation is given by  $s^4 + 2s^3 + 6s^2 + 4s + 1 = 0$ . (7)  
 b) Derive and explain Static Error Coefficient of Type 1 system. (7)

**MODULE III**

15. a) Construct the Bode plot for unity feedback system  $G(S) = 1000/[S(S+1)(S+10)]$ . Find the gain margin and phase margin. (8)  
 b) Explain P, PI, PID, controllers. (6)

OR

16. Sketch the root locus plot for the system whose open loop transfer function is given by  $GH(s) = \frac{k}{s(s^2 + 4s + 13)}$ . (10)

**MODULE IV**

17. a) Derive an expression for state transition matrix. (7)  
 b) Determine the state transition matrix of the following system (7)  

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} \begin{bmatrix} U_1 \\ U_2 \end{bmatrix}, Y(t) = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

**OR**

18. a) Obtain the state model from transfer function  $[s^3+8s^2+3s+2]Y(s)=U(s)$ . (7)
- b) Derive and show the relationship between state equation and transfer function. (7)

**MODULE V**

19. a) Explain the application of describing function for stability analysis of autonomous system. (9)
- b) Explain the nonlinearities in control system. (5)

**OR**

20. a) Explain Lyapunov methods to stability of linear and nonlinear continuous time systems (10)
- b) What is a nonlinear system? Explain. (4)

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