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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH. DEGREE EXAMINATION (R), DECEMBER 2023
ROBOTICS AND AUTOMATION
(2021 Scheme)

Course Code: **21RA105-C**

Course Name: **Non-linear Control Systems**

Max. Marks: **60**   **Duration: 3 Hours**

Provide ordinary Graph sheet

PART A
(Answer all questions. Each question carries 3 marks)

1. What are the characteristics of non-linear systems?
2. Derive the describing function of relay non-linearity.
3. Differentiate stability in the small with global stability.
4. Describe the role of integral control in feedback linearization?
5. Explain the stability analysis of non linear systems using Popov's criterion.
6. Explain the best controller for a robot manipulator.
7. Describe the recent developments in sliding mode control with its applications
8. What is chattering in SMC?

PART B
(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Explain the non-linearities present in the system given below
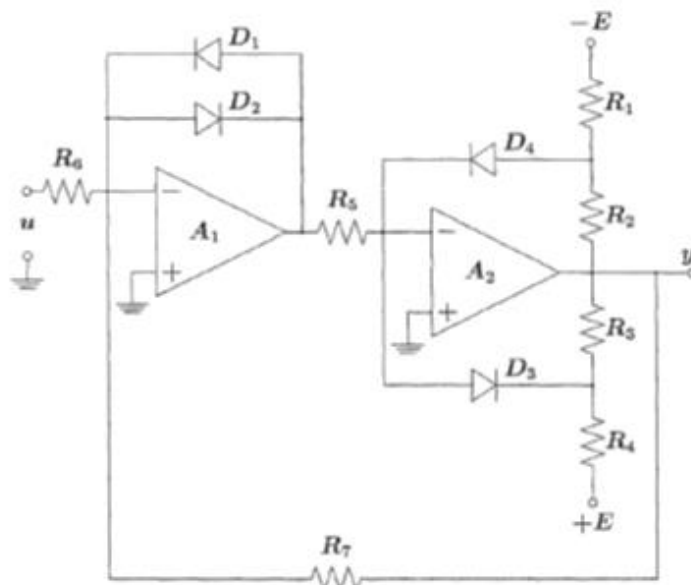
(6)

OR

10. Determine the singular point and construct the phase trajectory using isocline method for the system given by $\ddot{w} + 2\zeta\omega_n\dot{w} + w_n^2 = 0$. Where $\zeta = 0.15$, $\omega_n = 1$ rad/sec, $w(0) = 1.5$ and $\dot{w}(0) = 0$.   (6)

MODULE II

11. a) Explain the conditions for stability of oscillations.   (2)

    b) Derive the describing function analysis of saturation non-linearity.   (4)

OR

12. Derive the describing function analysis of deadzone non linearity.   (6)

MODULE III

13. Determine the stability of the system described by $\dot{X} = AX$, where $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$ by Lyapunov theorem and also find a suitable Lyapunov function.   (6)

OR

14. a) Explain the stability analysis of non-linear system.   (2)

    b) Explain second method of Lyapunov with equations.   (4)

MODULE IV

15. Explain about input output linearization with block diagrams   (6)

OR

16. a) With a neat block diagram explain the concept of state feedback linearization.   (4)

    b) What you mean by Full state Linearization.   (2)

MODULE V

17. a) Which are the thrust areas where adaptive control systems are more effective?   (3)

    b) Design a sliding mode control of non-linear system.   (3)

OR

18. With the help of suitable diagram explain Model Reference adaptive system. (6)

MODULE VI

19. a) With a neat block diagram explain variable structure control systems. (4)

    b) Write the properties of sliding motion. (2)

OR

20. a) Design a variable structure control system for a MIMO system. (3)

    b) Discuss the scheme used in flight control systems. (3)

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