INST/VII/CBGS/ACS | 08-12-2016

Advanced Control Systems.

Q.P. Code :798402

3 Hours **Total Marks :80**

Instructions: -

- Question one is compulsory
- Assume suitable data if necessary

Q1. Attempt any four (20)

a. Define nonlinear system and write detail classification of nonlinearities of system
b. Draw sinusoidal response of saturation with dead zone nonlinearity and write the response equation
c. Explain Jump resonance for nonlinear system
d. How to comment on stability using singular point.
e. Explain in details about limit cycle.

Q2. (a) For following system find of stability using singular point and draw trajectories. (10)

1. $\ddot{y} - 8\dot{y} + 17y = 34$
2. $\ddot{x} + \dot{x} + x^3 = 0$

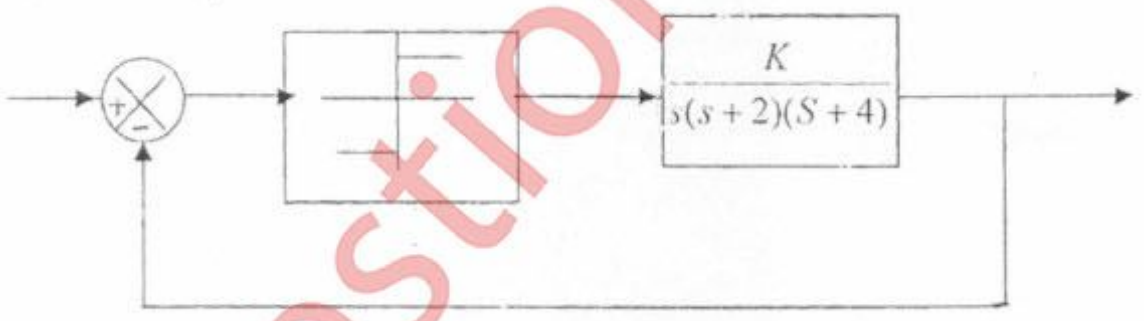
(b) Derive the describing function for relay with saturation. (10)

Q3. (a) Comment on Stability of the state space model given below using suitable Lyapunov function (10)

$$\dot{X}_1 = X_2 - X_1(X_1^2 + X_2)^2$$

$$\dot{X}_2 = -X_1 - X_2(X_1^2 + X_2)$$

(b) Investigate Stability using Describing function of following system which has unity relay signal as a nonlinearity. (10)



Q4. (a) Design IMC controller for plant model $G(s) = \frac{(-s+1)}{(2s+1)}$ to achieve the response with time constant of 1.5 Sec. (10)

(b) Design the optimal controller via Riccati equation for system

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

To minimize the performance index $J = \int_0^\infty (x_1^2 + x_2^2 + u^2)dt$ (10)

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Q5. (a) Determine stability using Krasovskii method (10)

$$x_1 = -x_1;$$

$$x_2 = x_1 - x_2$$

(b) Using variable gradient method find suitable Lyapunov function for the system given by (10)

$$x_1 = x_2$$

$$x_2 = -x_1^3 - x_2$$

Q6. (a) Explain in details IMC based PID controller Design/tuning. (10)

(b) Draw Phase Trajectory using delta method for given system, (10)

$$\ddot{x} + 5\dot{x} + 4x = 0$$