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QUESTION BANK (DESCRIPTIVE)

Subject with Code : Non Linear Control Theory (16EE7509)**Course & Branch**: M.Tech - CS**Year &Sem:** I-M.Tech& II-Sem**Regulation:** R16

UNIT –I

1 (a)Define linear and non linear control systems and explain their differences. [L1][5M]

(b)The response of a system is $y = ax^2 + e^{bx}$. Test whether the system is linear or non linear. [L4][5M]

2.Derive the describing function of Saturation Non-Linearity? [L4][10M]

3.(a)Explain the design of nonlinear system using describing function method. [L2][5M]

(b)Explain the concept of Jump Resonancewith neat sketches. [L2][5M]

4Derive the describing function of Dead-zone Non-Linearity? [L4][10M]

5 Derive the describing function of Relay with Hysteresis Non-Linearity? [L4][10M]

6 What is the significance of describing function analysis? [L1][10M]

7Derive the describing function of Ideal Relay Non-Linearity? [L4][10M]

8Derive the describing function of Relay with Dead-zone and Hysteresis Non-Linearity? [L4][10M]

9 Derive the describing function of Relay with Dead-zone Non-Linearity? [L4][10M]

10Derive the describing function of Dead-zone and Saturation Non-Linearity? [L4][10M]

UNIT –II

1 (a)Explain phase plane and phase trajectory with neat sketch? [L2][5M]

(b)Explain about the Singular points in phase plane analysis? [L2][5M]

2Whatisphaseplane,phasetrajectoryandphaseportrait?Drawandexplainhowtodeterminethe stable and unstable limit cycles using phase portrait. [L1][10M]

3Explain the different singular points with respect to stability of nonlinear systems. [L2][10M]

4Explain the construction of phase trajectories and explain procedure for constructing phase trajectories by Isocline method [L2][10M]

5 (a)Discuss about the phase plane techniquewhich can be used to analyze nonlinear system. [L2][5M]

(b) Explain the methods available for construction phase trajectories. [L2][5M]

6 A linear second order servo is described by the equation $\mathbf{\ddot{e} + 2\zeta \omega_n \dot{e} + \omega_n^2 e = 0}$,Where $\zeta = 0.15$, $\omega_n = 1$ rad/sec, e (0) = 1.5 and $\dot{e}(0) = 0$. Determine the singular point. Construct thephase trajectory, using the method of Isoclines. Choose slope as -2.0, -0.5, 0, 0.5 and 2.0. [L4][10M]

7(a)Whatis linearization? [L1][5M]

(b)Discuss in detail the input-state linearization. [L2][5M]

8(a) Whatisalimitcycle?Discussaboutthetheorems,bywhich,theexistenceoflimit cycle can be predicted. [L1][5M]

(b) Define input state linearization. State and prove the conditions for input state linearization. [L1][5M]

9 (a)Discuss input-output linearization.[L2][5M]

(b)State and prove the theorems for the existence of limit cycles [L1,L4][5M]

10Define linearization.Classify and explain the linearization methods in detail. [L1,L2][10M]

UNIT –III

1 (a)State and explain the second method of Lyapunov stability. [L2][5M]

(b)Explain direct method of Lyapunov applied to discrete time systems. [L2][5M]

2. Define the following: (i) System.(ii) Equilibrium state (iii) Stability in the sense of lyapunov (iv) Asymptotic stability in large.(v) Instability. [L1][10M]

3. Explain the terms:

(i) Positive definiteness. (ii) Negative definiteness. (iii) Positive Semi definiteness.

(iv) NegativeSemi definiteness. (v)In definiteness. [L2][10M]

4A second order system is represented by $\dot{X}$ = AX, A = $\begin{bmatrix} -1 & 1 \\ -2 & -4 \end{bmatrix}$ use Lyapunov theorem and determine the stability of the origin of the system. Write the Lyapunov function V(x).[L4][10M]

5 Determine Whether or not following quadratic form is positive definite

$Q(x_1, x_2) = 10x_1^2 + 4x_2^2 + x_3^2 + 2x_1x_2 - 2x_2x_3 - 4x_3x_1$. [L4][10M]

6 Using system of Lure problem state the Aizerman's and Kalman's conjecture. [L2][10M]

7WhatisthesignificanceofAizermanmethod?ExplainAizerman'smethodofconstruction ofLiapunov function? [L1][10M]

8 (a)What is meant by Aizerman conjecture? Explain its significance. [L1][5M]

(b) Explain construction of Lyapunov function byvariable gradient method. [L2][5M]

9 (a)State and explain the second method of Lyapunov stability. [L2][5M]

(b)Using system of Lure problem state the Aizerman's conjecture.[L2][5M]

10 (a)Explain direct method of Lyapunov applied to discrete time systems. [L2][5M]

(b)Using system of Lure problem state the Kalman's conjecture [L2][5M]

UNIT –IV

1 (a)State and explain Popov's hyperstability theorem with an example.[L1,L2][5M]

(b)Discuss circle criterion in detail. [L2][5M]

2State and explain Popov's stability criterion.[L1,L2] [10M]

3 (a)State and explain Popov stability criterion.[L1,L2][5M]

(b)State Popov lemma.[L2][5M]

4State and explain Popov's hyper stability theorem.[L1,L2][10M]

5 (a)State Popov's hyper stability theorem.[L1,L2][5M]

(b) Explain generalized circle criterion.[L2][5M]

6 (a)Explain the Kalmanstability criterion?[L2][5M]

(b)State Popov lemma.[L2][5M]

7(a)Explain the Yakubovichstability criterion?[L2][5M]

(b)State and explain Popov stability criterion.[L1,L2][5M]

8 (a)State and explain Popov's hyper stability theorem.[L1,L2][5M]

(b) Discuss circle criterion in detail.[L2][5M]

9 (a)Stateand explain Popov lemma.[L1,L2][5M]

(b)Explain generalized circle criterion.[L2][5M]

10Explain theKalman andYakubovichstability criterion?[L2][10M]

UNIT –V

1 (a)What is sliding control? What are the applications of sliding control? [L1,L3][5M]

(b)Explain how do you reduce chattering in sliding and steady state modes.[L2][5M]

2(a)State the classical reaching laws.[L2][5M]

(b)Explain the design of controller for sliding mode control based on reaching law.[L2][5M]

3 (a)State the classical reaching laws.[L2][5M]

(b)Explain the steps involved in the design of a ball and beam nonlinear system.[L2][5M]

4Explain the design aspects of flight control and robotic manipulator.[L2][10M]

5 (a)How the reduction of chattering is done in steady state mode?[L1][5M]

(b) Explain the design of robotic manipulator system.[L2][5M]

6 (a)Explain the reduction in chattering using sliding control.[L2][5M]

(b)Explain the design procedure for sliding mode controller based on a reaching law.[L2][5M]

7(a)Explain the designing of flight control system.[L2][5M]

(b)Discuss about reaching condition and reaching mode in detail.[L2][5M]

8 (a)How the reduction of chattering is done in steady state mode?[L1][5M]

(b) Explain the steps involved in the design of a ball and beam nonlinear system.[L2][5M]

9 (a)Explain the reduction in chattering problem in steady state.[L2][5M]

(b)Explain the design procedure for sliding mode controller based on a reaching law.[L2][5M]

10Explain the design aspects of robotic manipulatorandflight control.[L2][10M]

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