KUMARAGURU
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Register Number: …….

B.E DEGREE EXAMINATIONS: APRIL/ MAY 2016

(Regulation 2013)

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

U13EITE02**:** Advanced Control Systems

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The set of all possible values which the state X(t) can assume at time t forms the _____ of the system.
   a) State variable b) State space
   c) State model d) State diagram
2. The _____ is a phenomenon in which the output follows a different path for increasing or decreasing values of input.
3. A nonlinear system has _____ equilibrium point/points.
   a) One b) Two
   c) Multiple d) no
4. The locus of the describing function K_N is called critical locus. True or False?
5. In nonlinear systems stability is discussed relative to _____.
   a) Critical locus b) Limit cycle
   c) Equilibrium state d) Unstable node
6. The _____ exists at the intersection point of $-1/K_N$ locus and G(jw) locus.
7. In Aizerman's method, the non-linearity is approximated by _____.
   a) Function b) System
   c) Gain d) Fourier series
8. In nonlinear systems stability is discussed relative to equilibrium state. True or False?
9. The nth order system is completely observable if the rank of the composite matrix for observablility is
   a) n b) n+1
   c) n-1 d) n^2
10. The state observer can be designed only if the system is completely _____.

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

11. What is state space?
12. State two properties of state transition matrix.
13. Define phase plane, phase trajectory and phase portrait.
14. What is the difference between stability analysis of linear system and stability analysis of non-linear system?
15. Find the singular points of the system given by □ + 0.6 □ + 3 x + x^2 = 0.
16. Show the stability of the system due to nonlinearity by sketching -1/KN locus and G(jw) locus in complex plane.
17. Define asymptotically stable in large in the sense of Liapunov.
18. List the advantages of Aizerman's method over other linearization techniques.
19. What is full-order state observer?
20. What is meant by linear design and non-linear verification?

PART C (5 x 14 = 70 Marks)

(Answer not more than 400 words)

Q.No. 21 is Compulsory

21. A linear second order servo system is described by the equation

$$\ddot{e} + 2\zeta\omega_n\dot{e} + {\omega_n}^2 e = 0$$

where ζ = 0.15, ω_n= 1 rad/s, e(0) = 1.5 and $\dot{e}(0)$ = 0. Determine singular point and construct phase trajectory using the method of isoclines.

22. (a) Use the matrix inverse method to find a differential equation relating $V_L(t)$ to $V_S(t)$, given

$$\begin{bmatrix}\dot{V_c}\\ \dot{I_L}\end{bmatrix} = \begin{bmatrix}0 & 1/C\\ -1/L & -R/L\end{bmatrix}\begin{bmatrix}V_c\\ I_L\end{bmatrix} + \begin{bmatrix}0\\ 1/L\end{bmatrix} V_{in}(t)$$

$$V_L = -V_c - R\, I_L + V_S(t)$$

and when R = 2Ω, C=0.2 F and L=0.5 H check for observability using Kalmans method.

(OR)

(b) For the system $\dot{X}$ = AX(t), the response is X(t) = $\begin{bmatrix}e^{-2t}\\ -2e^{-2t}\end{bmatrix}$ when X(0) = $\begin{bmatrix}1\\ -2\end{bmatrix}$ and X(t) = $\begin{bmatrix}e^{-t}\\ -e^{-t}\end{bmatrix}$ when X(0) = $\begin{bmatrix}1\\ -1\end{bmatrix}$. Find A and State Transition Matrix.

23. (a) Derive the describing function for Relay with Dead-zone and hysteresis.

(OR)

(b) Derive the describing function for Backlash nonlinearity.

24. (a) Elaborate Lure's Transformation in detail.

(OR)

(b) Write about Popov's and Circle criterion.

25. (a) Prove that disturbance is rejected in Internal Model Control.

(OR)

(b) With neat block diagrams explain state feedback and state observer.

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