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Question Paper Code: 31563

B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER 2015

Fifth Semester

Instrumentation and Control Engineering

01UIC503 – ADVANCED CONTROL SYSTEM

(Regulation 2013)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. What is the need for observability test?
2. State the condition for controllability by Gilbert's method.
3. How the non-linearity is classified? Give examples.
4. How are calculated, when the Eigen vectors values are distinct?
5. What is the difference between phase plane and describing function methods of analysis?
6. Define limit cycles.
7. Classify scalar functions.
8. How the Sylvester's criterion expressed in quadratic form?
9. What is the role of state observer?
10. Write down the linear continuous-time state equation.

PART - B (5 x 16 = 80 Marks)

11. (a) Obtain the three canonical state model of the system whose transfer function is given

$$\text{as } \frac{Y(s)}{U(s)} = \frac{10}{s^3+4s^2+2s+1} \quad (16)$$

Or

- (b) Obtain the time response of the following system $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ where $u(t)$ is unit-step function occurring at $t=0$. (16)

12. (a) Draw and explain the construction of phase trajectories by using delta method. (16)

Or

- (b) A linear second order servo is described by the equation $\ddot{e} + 2\zeta\omega_n\dot{e} + \omega_n^2 e = 0$ Where $\zeta = 0.15$, $\omega_n = 1 \text{ rad/sec}$, $e(0) = 1.5$ and $\dot{e}(0) = 0$. Determine the singular point. Construct the phase trajectory, using the method of isoclines. (16)

13. (a) Deduce the expression for input-output characteristic describing function of backlash nonlinearity. (16)

Or

- (b) (i) The response of a system is $y = ax + b \frac{dx}{dt}$ test whether the system is linear or nonlinear. (8)

- (ii) The response of a system is $y = ax^2 + e^{bx}$ test whether the system is linear or nonlinear. (8)

14. (a) Determine the sign definiteness of the quadratic function

$$Q = 10x_1^2 + 4x_2^2 + x_3^2 + 2x_2x_1 - 2x_2x_3 - 4x_1x_3 \quad (16)$$

Or

- (b) Consider the dynamics of the system represented by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ Formulate the liapunov function to test the asymptotic stability of the system. (16)

15. (a) A first-order system is described by the differential equation $\dot{x}(t) = 2x(t) + u(t)$ It is desired to find the control law that minimizes the performance index. (16)

Or

- (b) Derive an iterative method for solving reduced matrix riccati equation. (16)