Reg. No. : | | | | | | | | | | |

Question Paper Code: 31653

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

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. Write the state model of LTI system.
3. How the non-linearity is classified? Give examples.
4. How are calculated, when the Eigen vectors values are distinct?
5. Define describing function.
6. Define limit cycles.
7. Classify scalar functions.
8. Give the general state equation for a nonlinear system.
9. What is the role of state observer?
10. Define optimal control.

PART - B (5 x 16 = 80 Marks)

11. (a) Obtain the three canonical state model of the system whose transfer function is given as $\frac{Y(s)}{U(s)} = \frac{10}{s^3+4s^2+2s+1}$ (16)

Or

(b) A system represented by state equation $\dot{X}(t) = AX(t)$. 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 $X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$. Determine the system matrix *A* and the state transition matrix. (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 $\ddot{e} + 2\rho\omega_n\dot{e} + {\omega_n}^2 e = 0$ where ρ = 0.15, ω_n=1rad/sec, e (0) = 1.5, $\dot{e}(0)$ = 0. Determine the singular point and construct the phase trajectory using the method of isoclines. Choose slope as -2, -0.5, 0, 0.5, and 2. (16)

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

Or

(b) Derive the describing function for a system with saturation nonlinearity. (16)

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) Describe Popov's criterion for stability analysis. (16)

15. (a) Discover the control law which minimizes the performance index $J = \int_0^\infty ({x_1}^2 + 0.25u^2)dt$ For the system $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 100 \end{bmatrix} u$. (16)

Or

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