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

Question Paper Code: 41653

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

Fifth Semester

Instrumentation and Control Engineering

14UIC503 - ADVANCED CONTROL SYSTEM

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. $\phi(s)$ is called the

   (a) State transition matrix (b) Resolution matrix
   (c) Resolvent matrix (d) Transfer matrix

2. In a system, all initial states are controllable. The system is said to be

   (a) Partially controllable (b) Uncontrollable
   (c) Infinity (d) Completely controllable

3. An equilibrium solution is a constant solution of the system, and is usually called a

   (a) Critical Point (b) Stationary Point
   (c) Linear Point (d) Non-linear Point

4. The coordinate plane with the state variables x_1 and x_2 as two axes is called

   (a) phase trajectory (b) phase portrait (c) phase plane (d) singular point

5. In many cases the system presents a nonlinear phenomenon which is fully characterized by its _____ characteristics.

(a) Dynamic (b) First order (c) Static (d) Second order

6. A locus passing through the points of same slope in phase plane is called

(a) limit cycles (b) phase portrait (c) phase plane (d) isoclines

7. The system describe by $\dot{x}(t) = F(x(t))$, a state $x_e(t)$ where $F(x_e(t)) = 0$; for all t is called as a/ an _____ of the system.

(a) Un stable (b) Stable
(c) Equilibrium state (d) Un stable equilibrium state

8. The linear autonomous system is $\dot{x} = Ax$, where *A* is

(a) $n \times n$ real constant matrix (b) $m \times n$ real constant matrix
(c) $n \times 1$ real constant matrix (d) $1 \times n$ real constant matrix

9. A control system is optimum when the selected performance index is

(a) Maximized (b) Controlled
(c) Non controlled (d) Minimized

10. The optimal control theory is applicable for

(a) Multivariable system (b) SISO
(c) Autonomous system (d) None of these

PART - B (5 x 2 = 10 Marks)

11. Define Pole Placement.

12. List two properties of non linear systems.

13. List the various types of non linearity's in control system.

14. List two analysis of non linear system.

15. What is multivariable control?

PART - C (5 x 16 = 80 Marks)

16. (a) Explain the design of state observer and full order state observer in detail. (16)

Or

(b) Consider a linear system described by the transfer function $\frac{Y(s)}{U(s)} = \frac{10}{s(s+1)(s+2)}$.

Design a feedback controller with a feedback so that the closed loop poles are placed at -2, $-1 \pm j1$. (16)

17. (a) Construct a phase trajectory by delta method for a non linear system represented by the differential equation, $\ddot{x} + 4\dot{x} + 4x = 0$. Choose the initial condition as $x(0) = 1.0$ and $\dot{x}(0) = 0$. (16)

Or

(b) Describe the limit cycles in linear and non-linear systems with examples. (16)

18. (a) Derive the describing function of dead-zone nonlinearity. (16)

Or

(b) The input x (t) and the output y (t) of a nonlinear device are related through the differential equation y (t) = $(dx / dt)^3 + x^2 (dx / dt)$. Determine the describing function for this device. (16)

19. (a) Investigate the stability of the system described by

$$\dot{x}_1 = x_2 .$$

$$\dot{x}_2 = - x_2 - x_1^2 x_2$$

(16)

Or

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

20. (a) Explain the time varying optimal control in detail, with an example. (16)

Or

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