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

Question Paper Code: 45603

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

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. The concepts of controllability and observability were introduced by

   (a) Gilbert (b) Kalman (c) Gibson (d) None of these

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. Non linear systems often have______________ steady-state solutions.

   (a) Single (b) Multiple (c) One or Two (d) Zero

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. The describing function is a linear approximation of the static nonlinearity limited to the _________ harmonic.

   (a) 1 (b) 2 (c) 3 (d) 4

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. In the following equations, which one is named as negative – definite scalar function based on Liapunov's stability criterion?

(a) $\frac{dV(x)}{dt}$ (b) $\frac{dV^2(x)}{dt^3}$ (c) $dV(x)$ (d) $\frac{dV}{dt}$

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. Express Matrix Riccati equation.

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 ± j1. (16)

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

Or

(b) Use the method of isoclines to draw the direction field for the following differential equation (16)

$$\frac{dy}{dt} = y - t$$

18. (a) (i) A nonlinear electronic device produces an output that is the cube of its input (i.e. $y = x^3$). Derive the describing function of the device. (8)

(ii) The input x (t) and the output y (t) of a nonlinear system are related through the nonlinear differential equation $y(t) = x^2(dx / dt) + 2x$. Determine the describing function of the system. (8)

Or

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

19. (a) Using the Lyapunov equation, examine the stability range for the gain *K* of the system shown in figure-1. (16)

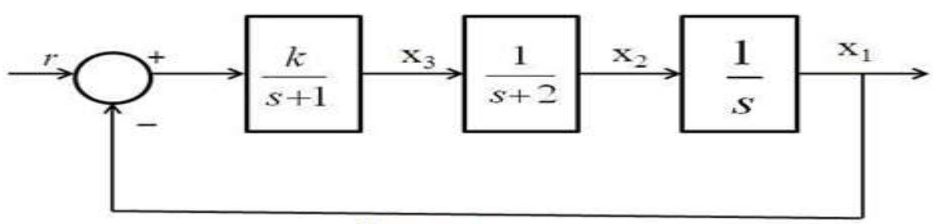

Figure 1

Or

(b) Investigate the stability of the system described by (16)

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

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

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 $J = \int_0^\infty \left(x_1^2 + 0.25u^2\right)dt$. 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)