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

Question Paper Code: 45603

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

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 variable which determine the state of a dynamical system, are called

   (a) State-analysis (b) State-vector
   (c) State-variables (d) State-space

3. 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

4. The purpose of intentionally introducing nonlinearities into the system is

   (a) to improve the system performance
   (b) to reduce the system performance
   (c) to complex the construction of the system
   (d) not alter the system performance

5. 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

6. Which of the following is the example of the non linear system

(a) $y = ax^2 + e^{bx}$ (b) $y = ax + b\frac{dx}{dt}$

(c) $y = ax^2 + b\frac{dx}{dt}$ (d) $y = a^2 x + e^{bx}$

7. 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

8. An unforced (i.e., $u = 0$) and time invariant system is called

(a) Linear system (b) Non linear system
(c) Autonomous system (d) None of these

9. The optimal control theory is applicable for

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

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. Define describing function.

14. List two analysis of non linear system.

15. Express Matrix Riccati equation.

PART - C (5 x 16 = 80 Marks)

16. (a) Determine the matrix exponential, state transition matrix, and the homogeneous response to the initial conditions $X_1(0) = 2$, $X_2(0) = 3$ of the system with state equations. (16)

$$\dot{x}_1 = -2x_1 + u$$
$$\dot{x}_2 = x_1 - x_2.$$

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

(16)

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

Or

(b) Derive the describing function of saturation nonlinearity. (16)

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

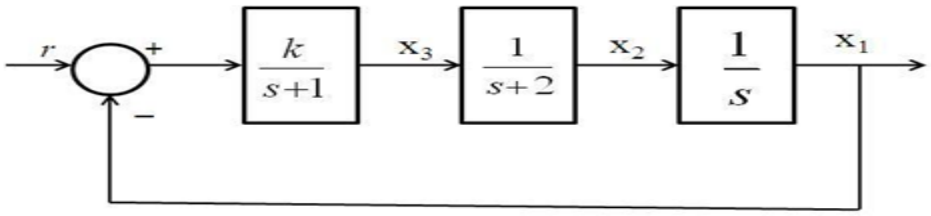

Figure 1

Or

(b) 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. (16)

$J = \int_0^\infty \left(x_1^{\,2} + 0.25u^2\right)dt$. For the system $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}x + \begin{bmatrix}1\\ 100\end{bmatrix}u.$