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324732(24)

B. E. (Seventh Semester) Examination, Nov.-Dec. 2018

(New Scheme)

(Elect. Engg. Branch)

MODERN CONTROL SYSTEM

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Attempt all questions. Part (a) from each question is compulsory. Attempt any two parts from part (b), (c) and (d) of each question.*

Unit-I

1. (a) What are stable and unstable limit cycles. 2

(b) What are describing functions? Derive the describing function for a saturation non-linearity. 7

(c) Derive the describing function of a relay with dead zone. 7

(d) Explain the differences between linear and non-linear systems. 7

Unit-II

2. (a) What is the state and state variable. 2

(b) Evaluate the state transition matrix by series summation method for 7

$$A = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$$

(c) Obtain the state space representation in the controllable cannonical form and diagonal cannonical form for the system given by : 7

$$\frac{Y(s)}{U(s)} = \frac{(S+3)}{S^2+3S+2}$$

(d) Prove that :

$$A = \begin{bmatrix} -a_1 & 1 & 0 & \cdots & 0 & 0 \\ -a_2 & 0 & 1 & \cdots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ -a_{n-1} & 0 & 0 & \cdots & 0 & 1 \\ -a_n & 0 & 0 & \cdots & 0 & 0 \end{bmatrix}$$

diagonalizing matrix is given by :

$$\begin{bmatrix} 1 \cdots\cdots 1 \\ \lambda_1 + a_1 \cdots\cdots \lambda_n + a_1 \\ \lambda_1^2 + a_1\lambda_1 + a_2 \cdots\cdots \lambda_n^2 + a_1\ \lambda_n + a_2 \\ \vdots \qquad\qquad \vdots \\ \lambda_1^2 + a_1\lambda_1^{n-2} + \cdots + a_{n-2}\lambda_1 + a_{n-1} \cdots\cdots \lambda_n^{n-1} + a_1\lambda_n^{n-2} + \cdots\cdots + a_{n-2}^{\lambda} n + \end{bmatrix}$$

Unit-III

3. (a) Define positive and negative definiteners. 2

(b) Discuss the Liapunov four stability theorem. 7

(c) The second order system is describe by :

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$ 7

Explain the stability using Liapunov theorem. Also find Liapunov function. 7

(d) Examine the method of constructing Liapunov function using Krasovskii's method 7

Unit-IV

4. (a) What is state observer. 2

(b) Derive the Ackermann's formula for determination of state feedback gain matrix K. 7

(c) Explain the effect of the addition of the observer on closed loop system. 7

(d) Determine the stability of a sampled data control system having the following characteristic polynomial

$$P(z) = z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.08 = 0$$

Using Jury's Test. 7

Unit-V

5. (a) What is zero order hold? 2

(b) Describe the impulse sampling and data hold circuit. 7

(c) Explain the optimal control problem and performance index for optimal control problem. 7

(d) Explain the following :

(i) Zero Order Hold

(ii) Mapping between S-plane and Z-plane. 7