

Printed Pages : 4



EEE052

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 121856

Roll No.

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B. Tech.

(SEM. VIII) THEORY EXAMINATION, 2014-15
ADVANCED CONTROL SYSTEM

Time : 3 Hours]

[Total Marks : 100

Note : Attempt all questions.

- 1 Attempt any two parts of the following : 10×2=20
 (a) Consider a system given by following equation :

$$\frac{d^3 y}{dt^3} + 9 \frac{d^2 y}{dt^2} + 15 \frac{dy}{dt} + 5y = 8u$$

Find the phase-variable form of the state-space representation of the system.

- (b) Consider the state model

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u$$

$$x_1(0) = 0, \quad x_2(0) = 1, \quad u = \text{unit step}$$

Compute the STM and find the time response.

- (c) Consider a system described by the differential equation

$$\frac{d^2 y}{dt^2} + 5 \frac{dy}{dt} + 4y = u$$

Derive the state-space representation of the system and obtain suitable transformation to get the diagonalization.

- 2 Attempt any two parts of the following : $10 \times 2 = 20$

- (a) Examine the observability of the system described by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$y(t) = [3 \quad 4 \quad 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

- (b) Given discrete time state equation

$$x[n+1] = Ax[n] + Bu[n]$$

Show that

$$\sum_{i=0}^{n-1} A^{n-i-1} Bu[i] = Z^{-1} \left[(ZI - A)^{-1} B \cup (Z) \right]$$

- (c) Solve the difference equation

$$y[n+2] + 3y[n+1] + 2y[n] = u[n]; \quad y[0] = 1$$

$$y[n] = 0 \quad \text{for } n < 0.$$

3 Attempt any two parts of the following : $10 \times 2 = 20$

(a) A non-linear system is described by

$$\dot{x}_1 = -3x_1 + x_2$$

$$\dot{x}_2 = x_1 - x_2 - x_2^3$$

Investigate the stability of the system.

(b) Describe the “Krasovskii’s method” of constructing Lyapunov’s function for the assessment of the stability of a non-linear system.

(c) Consider the system described by state-equation

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} x$$

Determine whether the system is stable or not ?

4 Attempt any two parts of the following : $10 \times 2 = 20$

(a) State principle of optimality. Also derive the necessary condition for the control to be optimal in the sense of minimum value of performance index J .

(b) A system is described by

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

$$\dot{x}_2 = u$$

$$y = x_1$$

Obtain the control law which minimizes

$$J = 0.5 \int_0^{\infty} (u^2 + y^2) dt$$

(c) What is adaptive control ? Differentiate between feedback control and adaptive control. Also describe various schemes of adaptive control.

5 Attempt any two parts of the following : $10 \times 2 = 20$

- (a) Differentiate 'crisp sets' and 'fuzzy sets'. How a fuzzy inference mechanism infers a set of control actions for the given fuzzy inputs ?
- (b) Describe the "Infinite-time state-Regular Problem."
- (c) Discuss the 'Gilbert Test' for complete state controllability by means of suitable examples.
