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Total No. of Questions : 08

M.Tech. (EE) (2018 Batch) (Sem.–2)

ADVANCE CONTROL SYSTEM

Subject Code : MTEE-203A-18

M.Code : 76102

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1.Attempt any FIVE questions out of EIGHT questions.

2.Each question carries TWELVE marks.

SECTION-A

Q1 Obtain the state space representation of the system shown below :

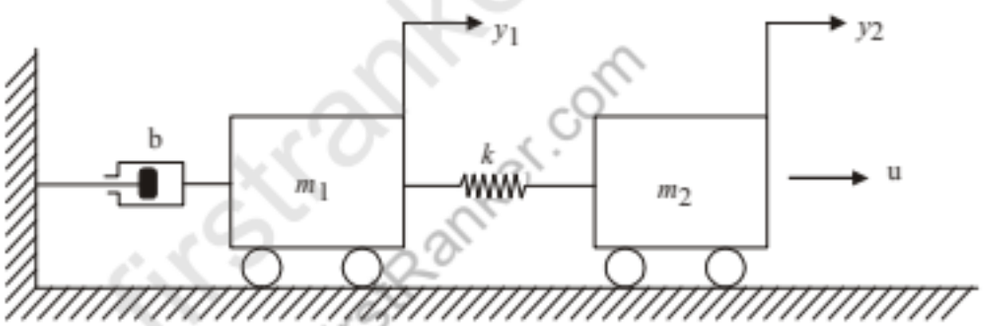

Fig.1

Q2 Consider the following state space representation of a system:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 6\end{bmatrix}u$$

$$y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

Obtain the eigen values of the matrix A. Also develop the system in diagonal canonical form.

Q3 Define Observability. For the system defined by :

$$\dot{X} = AX + BU$$

Derive the condition for complete state Observability.

Q4 Discuss the properties of Lyapunov function. Discuss any two methods for finding out the Lyapunov function.

Q5 Consider the system given by:

$$\dot{X} = AX + BU$$

$$y = CX$$

$$A = \begin{bmatrix} -1 & 0 & 1 \\ 1 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix}$$

Transform the system equations into observable and controllable canonical form.

Q6 Discuss the concept of an observer in control theory. Consider a system defined by :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1.244 & 0.3956 & -3.145 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1.244 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Given the set of desired poles of the observer to be

$$s = -5 + j5\sqrt{3}, \quad s = -5 - j5\sqrt{3}, \quad s = -10$$

design a full order observer.

Q7 Determine the optimal control signal U for the system defined by:

$$\dot{X} = AX + BU$$

Where $A = \begin{bmatrix} 0 & 1 \\ 0 & -1 \end{bmatrix}$ *and* $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

Such that the following performance index is minimized:

$$J = \int_0^\infty (X^T X + U^2)\, dt$$

Q8 Write a short note on :

(a) Similarity transformation

(b) Kalman filter

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.