Hall Ticket Number :										

R14

Code: 4P6211

M.Tech. I Semester Supplementary Examinations Aug/Sep 2016

Modern Control theory

(Common to EPE & EPS)

Max. Marks: 60 Time: 3 Hours

Answer *all five* units by choosing one question from each unit (5 x 12 = 60Marks)

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UNIT–I

1. a) Explain the linear transformation and matrices 4M

b) Show that the set of all real polynomials in x of degree≤ 2 forms a linear space with the usual definition of addition and scalar multiplication. Is the set of all real polynomials in x of degree 2 a vector space? 8M

OR

2. a) Describe the vector and matrix norms 4M

b) Find the Eigen values, Eigen vectors and Jordan form representations for the following matrix

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 3 \\ -1 & -2 & -1 \end{bmatrix}$$

8M

UNIT–II

3. a) State and prove the properties of STM 4M

b) Determine the state controllability and observability for the systems represented by the following state equations.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u, \text{ check with } y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

8M

OR

4. a) Derive the state models for linear continuous time system 4M

b) Discuss the state controllability and observability of the following system

$$[\dot{x}] = \begin{bmatrix} -3 & -1 \\ -2 & 1.5 \end{bmatrix} [x] + \begin{bmatrix} 1 \\ 4 \end{bmatrix} [u]$$

8M

UNIT–III

5. A linear time invariant system is described by the following state model. Obtain the canonical form of the state model.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ -2 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u \text{ and } y = \begin{bmatrix} \frac{14}{5} & \frac{6}{5} & -\frac{1}{5} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

12M

OR

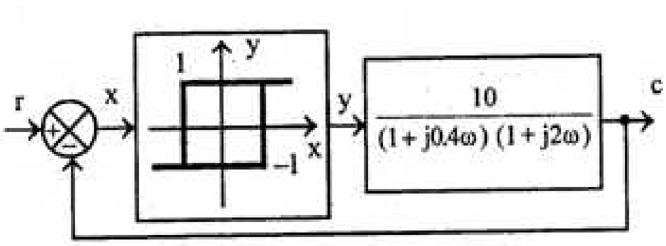
6. Consider the system defined by $\dot{x} = Ax$, $y = Cx$ where

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

Design a full-order state observer. The desired observer poles are s = -5 and s = -5.Also derive necessary expressions. 12M

UNIT–IV

7. The block diagram of a system with hysteresis is shown in figure. Using describing function method, determine whether limit cycle exists in the system. If limit cycles exists then, determine their amplitude and frequency.



12M

OR

8. A simple servo is described by the following equations

Reaction torque = $\ddot{\theta}_c + 0.5\dot{\theta}_c$

Drive torque = 2 $sign\,(e + 0.5\dot{e})$

$e = \theta_R - \theta_c$

$e(0) = 2 \, and \, \dot{e}(0) = 0$

Construct the phase trajectory using the delta method 12M

UNIT–V

9. For the system $\dot{x} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} x$

Find the suitable lyapunov function $V_{(x)}$ obtain an upper bound on the response time such that it takes the system to go from a point on the boundary of the closed curve $V_{(x)}$=100 to a point within the closed curve $V_{(x)}$= 0.05. 12M

OR

10. Briefly describe the formulation of the optimal control problem 12M

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