G 807 (Pages : 4) Reg. No.................................

Name.................................

B.TECH. DEGREE EXAMINATION, MAY 2014

Eighth Semester

Branch : Applied Electronics and Instrumentation Engineering

MODERN CONTROL THEORY (A)

(Old Scheme—Supplementary/Mercy Choice)

[Prior to 2010 Admissions]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions briefly.*
Each question carries 4 marks.

1. Derive a state model in diagonal form for the system described by :

$$\frac{Y(s)}{U(s)} = \frac{s^2 + 4s + 4}{s^3 + 5s^2 + 4s}.$$

2. Obtain a state model for the system described by

$$y(k+3) + 3y(k+2) + 2y(k+1) + y(k) = 5u(k).$$

3. Obtain state transition matrix for the system described by $\dot{x} = \begin{bmatrix} 0 & 2 \\ -3 & -5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ using Laplace Transform method.

4. Find the transfer function of the system having state model

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \text{ and } y = [1 \ \ 0]x.$$

5. Check the observability of the system described by $X = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x, \quad Y = [1 \ \ 0] X.$

6. Define complete state controllability and complete observability of a system.

7. Define state regulator problem and output regulator problem.

Turn over

8. Explain the pole placement design with state feedback in discrete system.

9. What are the use of the following operators in matlab ?

(a) :

(b) ;

(c) >>

(d) %

10. Write any two MATLAB functions and explain their functioning in control system ?

($10 \times 4 = 40$ marks)

Part B

Answer **all** *questions.*

Each full question carries 12 *marks.*

11. A discrete system is described by :

$$y(k+2) + 5y(k+1) + 6y(k) = u(k) \quad y(0) = y(1) = 0, \quad T = 1 \text{ sec.}$$

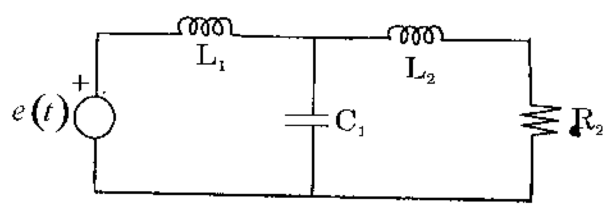
(a) Determine a state model in canonical form.

(b) Find state transition matrix.

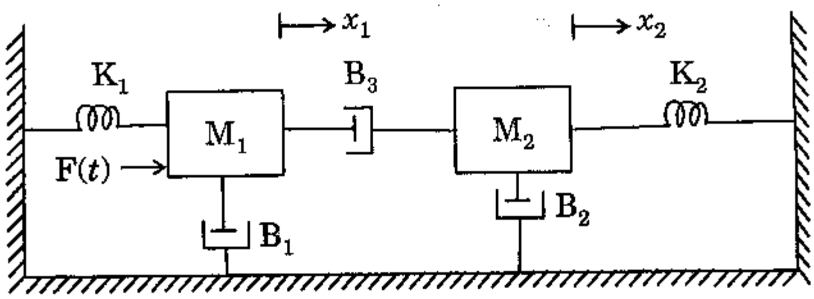
(c) For input $u(k) = 1,\ k \geq 1,$ find output $y(k)$.

Or

12. Write the state equations of the following system :



13. Obtain the transfer function and therefore the state model for the system shown in the figure below :



Or

14. (a) Obtain a state model for the system whose transfer function is $\frac{s^2+6s+8}{(s+3)\left(s^2+2s+2\right)}$.

(b) Construct the state model using phase variables if the system is described by

$$\frac{d^3y(t)}{dt^3} + 4\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 2y(t) = 5u(t).$$

15. Derive the state space model of a distillation column.

Or

16. Determine the controllability and observability properties of the following system :

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}, \quad B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix}, \quad C = [0 \quad 0 \quad 1].$$

17. A regulator system has the plant $\dot{x} = \begin{bmatrix} 0 & 0 \\ 20.6 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$, $y = [1 \quad 0]\, x$. Design a control law $u = -K\,x$, so that the closed loop system has eigenvalues at $-1.8 \pm j\,2.4$.

Or

18. Consider the system described by the state model $\dot{X} = AX$ where $A = \begin{bmatrix} -1 & 1 \\ 1 & -2 \end{bmatrix}$, $C = [1 \quad 0]$, $y = CX$. Design a full order state observer. The desired eigen values for the observer matrix are $\mu_1 = -5$, $\mu_2 = -5$.

19. Show how the tool boxes in the MATLAB and simulink are used to model a system, with an appropriate example.

Or

20. A linear time-invariant system is characterized by homogeneous state equation $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. Using MATLAB program, show how the solution of the homogeneous equation is computed, assuming the initial state vector $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$.

(5 × 12 = 60 marks)