No. of Printed Pages : 4 **BIEEE-017**

00221

B.Tech. ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

June, 2013

BIEEE-017 : ADVANCED CONTROL SYSTEM

Time : 3 Hours *Maximum Marks : 70*

Note : *Attempt **any seven** questions out of **10** questions. Use of scientific calculator is permitted.*

1. Consider the model of a speed control system with following state variable model **10**

$$A = \begin{bmatrix} -1 & 1 \\ -1 & 10 \end{bmatrix};\ B = \begin{bmatrix} 0 \\ 10 \end{bmatrix};\ C = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

Evaluate the response of this system to unit step input under zero initial conditions.

2. Determine the conditions on b_1, b_2, d_1, d_2 so that the system is completely controllable and observable. **10**

$$\dot{x} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} x + \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} u$$

$$y = [d_1\ d_2]\ x$$

3. The state variable model of a plant is given by : **10**

$$\dot{x} = Ax + Bu \qquad y = Cx$$

Where $A = \begin{bmatrix} 0 & 1 \\ 0 & -5 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$; $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$

Obtain its discrete time state model for $T = 0.1s$.

4. Solve the following difference equation using Z transformation **10**

$$y\ (K+2)\ + \frac{1}{4}y(K+1) - \frac{1}{8}y(K) = 3\ r(K+1) - r(K)$$

with input $r(K) = (-1)^K\ u(K)$

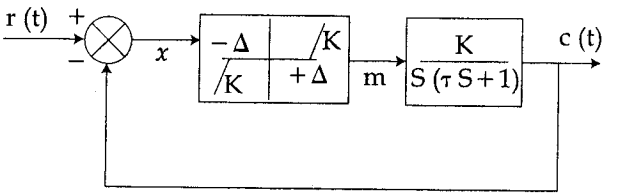
$u(K)$ = step input and initial conditions $y(-1) = 5$, $y(-2) = 6$

5. Determine the asymptotic stability using the second method of Lyapunov for the system dynamics given as **10**

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

6. The figure shows a non-linear control system with dead zone type non-linearity. Assume the minimum phase transformation is given by : **10**

$$G(S)\,H(S) = \frac{K}{S(\tau S+1)}$$



Determine the possibility of a limit cycle in the system.

7. Explain in brief the principle of optimality. Determine the optimal control law for the system described by : **10**

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

such that the following performance index is minimized

$$J = \int_0^\infty (x^T + u^2)\,dt$$

8. (a) Discuss the boundary value problem and its solution. **2x5=10**

(b) State and explain Hamilton-Jacobi equation.

9. (a) What are the main functions in an adaptive control system ? Explain in detail. **2x5=10**

(b) Compare model reference adaptive control with self tuning regulator.

10. (a) Define the term 'performance index' as used in self adaptive control system. Give its general characteristics. **2x5=10**

(b) Give the various controller structures used in adaptive control system.