Reg. No. : .....

Name : .....

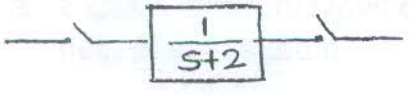
Eighth Semester B.Tech. Degree Examination, May 2013
(2008 Scheme)
08.801 – ADVANCED CONTROL THEORY (E)

Time: 3 Hours Max. Marks : 100

Instructions : *Answer* ***all*** *questions from Part – **A** and* ***any one*** *question from* ***each*** *Module in Part – **B**.*

PART – A

1. What are the limitations of classical control theory ?
2. Explain the following terms :
   i) State variable
   ii) State trajectory.
3. What is the general format of state space model of an n^{th} order system in (i) controllable and (ii) observable canonical forms ?
4. What are the two issues of significance in design of modern control theory ?
5. Find G (z) for the given system.



6. Evaluate Z-inverse for the given system.

$$F(z) \quad \frac{1+z^{-1}+2z^{-2}-z^{-3}+3z^{-4}}{1+2z^{-1}+3z^{-2}}$$

7. Distinguish between stable and unstable limit cycle.

8. Define describing function. What are the limitations of non linear system analysis using describing function ?

9. What are the main characteristics of non-linear systems ?

10. What you mean by phase trajectory ? Draw a typical phase trajectory of a second order system for different damping ratio. **(10×4=40 Marks)**

PART – B

Module – I

11. a) Obtain the state space model of closed loop transfer function in observable canonical form $\frac{Y(s)}{U(s)} = \frac{s^2 + 3s + 3}{s^3 + 2s^2 + 3s + 1}$. 10

b) Obtain transfer function from the given state space model

$$\dot{X} = \begin{bmatrix} 0 & 0 & -7 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix} X + \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} X$$ 10

12. a) Compute solution for the given state space model

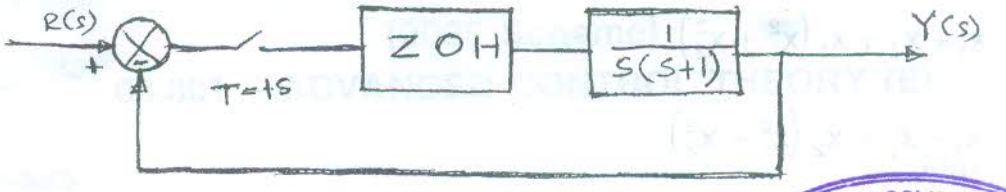
$$\dot{X} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} X \text{ and } X_0 = \begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}$$ 10

b) Examine the controllability and observability of the given system $\dot{X} = AX + BU$ where, $Y = CX$ 10

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

Module – II

13. a) For the given sampled data control system, find step response 8



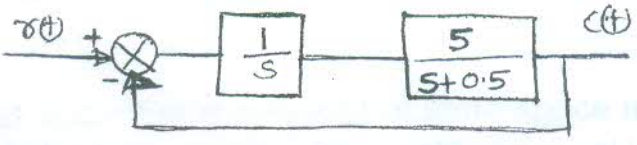
b) State and explain Shannon's sampling theorem. 4

c) Solve the difference equation

$x(k+2) + 3x(k+1) + 2x(k) = 0$; $x(0) = 0$ and $x(1) = 1$. 8

14. a) Explain stability analysis of discrete system using Jury's test and Routh-Herwitz criterion. 10

b) Determine pulse transfer function of the system shown in figure

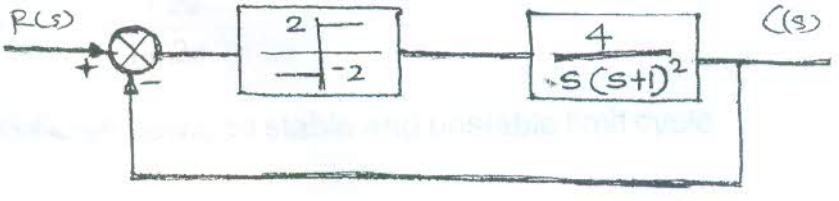


Is the system stable for (a) sampling time T = 0.5s and (b) T = 1s 10

Module – III

15. a) Explain different types of nonlinearities presented in control system with the help of neat sketch. 10

b) For the nonlinear system shown in figure investigate the possibility of limit cycle 10



16. a) Compare stability analysis of non-linear system using describing function and phase plane analysis. 10

b) A system is described by following equation 10

$$\dot{x}_1 = -x_1 + x_2 + x_1\left(x_1^2 + x_2^2\right)$$

$$\dot{x}_2 = -x_1 - x_2 + x_2\left(x_1^2 + x_2^2\right)$$

Determine the asymptotic stability using Liapunov method.

(3×20=60 Marks)