Sixth Semester B.Tech. Degree Examination

(2013 Scheme)

13.601 ADVANCED CONTROL SYSTEMS (E)

Time: 3 Hours Max. Marks: 100

PART- A

(Answer all questions. Each question carries 4 marks.)

1. What are the advantages of the state space analysis?
2. Prove that the set of state variables for a system is not unique.
3. Explain Shannon's sampling theorem.
4. Write notes on Jump resonance.
5. Determine the positive definiteness of

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

(5 X 4 Marks =20)

PART- B

(Answer any one full question from each module)

Module – I

6. a) Transfer function of a system is

$$\frac{Y(s)}{\cup(s)}=\frac{10(s+4)}{s^3+4s^2+3s}$$

Obtain state space model in the canonical form. Hence determine the eigen values of the system matrix

(10 Marks)

b) Solve

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -3 & -2 \end{bmatrix} X; \qquad X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

(10 Marks)

(OR)

7. Consider a system represented by the state equation $\dot{X} = AX$

$$is = \begin{bmatrix} e^{-t} + te^{-t} & te^{-t} \\ te^{-t} & e^{-t} - te^{-t} \end{bmatrix}$$

Given State transition matrix

(a) Find a set of states $x_1(0)$ and $X_2(0)$ such that $x_1(2) = 2$

(b) Find system matrix

(20 Marks)

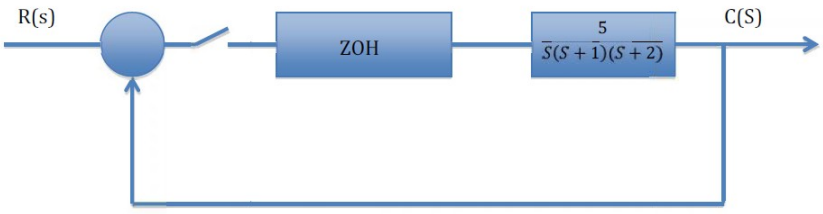
Module-II

8. (a) Solve the Difference equation by use of z-transform method.

$$x(k) - 3x(k-1) + 2x(k-2) = 4^k$$

(10 Marks)

(b) Find the step response of the given sampled data system



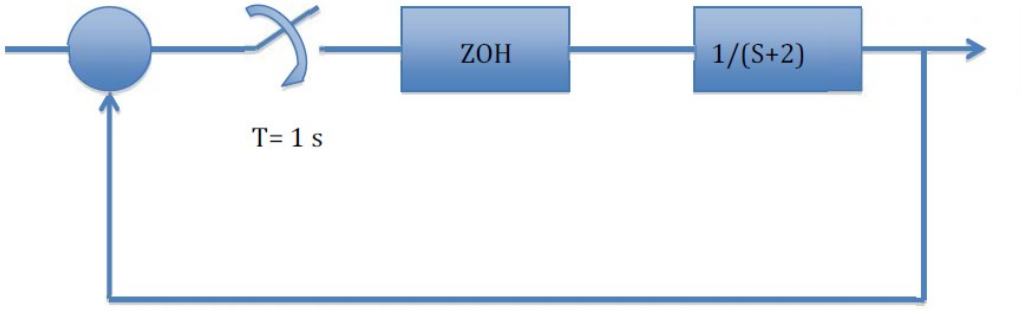
(10 Marks)

(OR)

9. a) Explain how s-plane is mapped into z-plane (5 Marks)

b) Obtain the pulse transfer function of the sampled data control system.

Find output c(k) for r(t) = u(t).

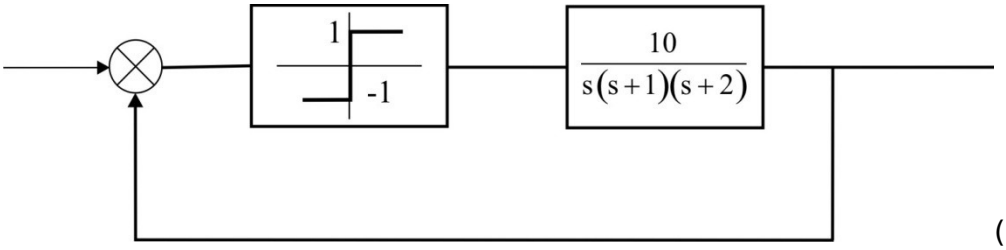


(15Marks)

Module-III

10. a) Explain with diagram different types of nonlinearities (5 Marks)

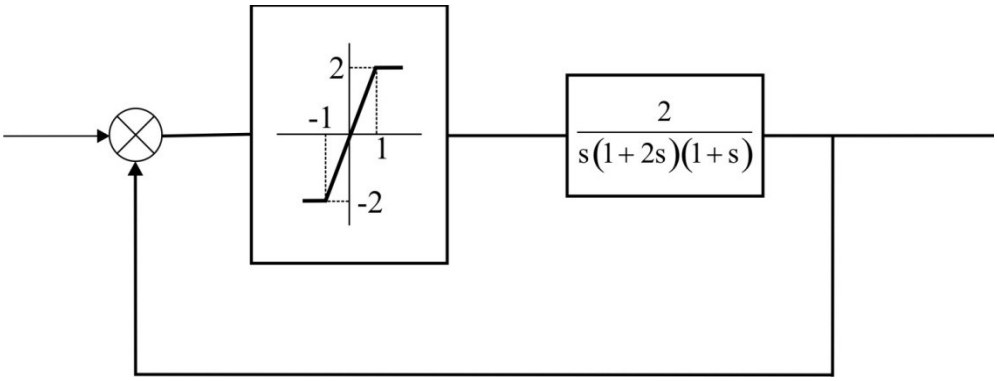
b) For the non-linear system given below, investigate the possibility of a limit cycle. If limit cycle exists, find its magnitude and frequency.



(15 Marks)

11. a) Derive the describing function of saturation non-linearity. (5 Marks)

b) For the non-linear system given below, investigate the possibility of a limit cycle. If limit cycle exists, find its magnitude and frequency.



(15 Marks)

Module-IV

12. a) Write notes on singular points (5 Marks)

b) A system is described by the following equation:

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

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

Determine the stability using Liapunov method.

(15 Marks)

(OR)

13. a) Write notes on phase plane analysis (5 Marks)

b) Given

$$\begin{bmatrix}\dot{x_1}\\ \dot{x_2}\end{bmatrix} = \begin{bmatrix}0 & 1\\ -1 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

Find a Liapunov function and test the stability (15 Marks)