b) Describe various methods of stability of nonlinear control system and explain one of them with example.

8. a) Discuss the Popov's stability criterion for nonlinear control system.

b) State and explain Bendixson's theorem with example.

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Roll No .....

MEIC - 103

M.E./M.Tech., I Semester

Examination, December 2015

Discrete Data And Non Linear Control

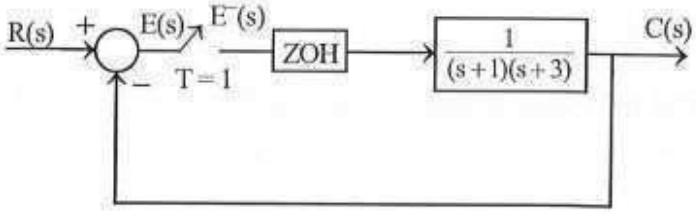
Time : Three Hours

Maximum Marks : 70

Note : i) Attempt any five questions.

ii) All questions carry equal marks.

1. a) Calculate the steady state errors of unit step, unit ramp and unit parabolic inputs for the system shown in figure.



b) Plot the impulse response of ZOH (Zero Order Hold) and also explain the magnitude and phase characteristics.

2. a) A discrete time system is described by the following difference equation.

$y(k+2) + 0.5y(k+1) + 0.06y(k) = -(0.5)^{k+1}$

The initial conditions are $y(0)=0$, $y(1)=0$.

Find out the solution $y(k)$ for $k > 0$.

b) Consider the following discrete transfer function

$$G(z)=\frac{z+2}{z^2+0.4z-0.96}$$

Find out the state variable model in three different canonical forms.

3. a) Discuss and explain the optimization of digital controllers with example.

b) Describe the phenomenon of compensation of sampled data control system.

4. a) Consider the following system

$$\dot{x}_1 = 2x_1 - x_1x_2$$

$$\dot{x}_2 = 2x_1^2 - x_2$$

Find all equilibrium points of the system and obtain a linear model about each of them. Further, transform the linear system into appropriate canonical form and comment on the nature of the equilibrium point.

b) Discuss about the linearization and harmonics of nonlinear control system.

5. a) Show how the stability analysis of third-order type-1 system having relay with dead zone type nonlinear element is explained. Draw neat Nyquist diagram to show the analysis.

b) Explain the ON-OFF control of liquid-level system with drawing of its complete layout. Discuss only the one-point control.

6. a) Determine the stability of the following system by solving Lyapunov matrix equation.

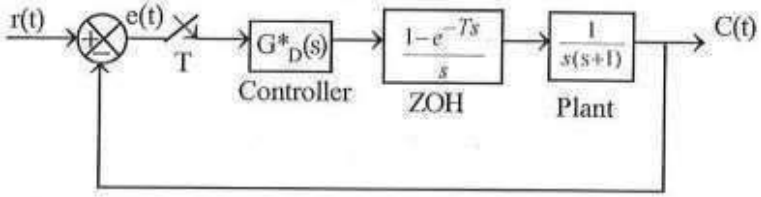
$$x(k+1)=\begin{bmatrix}-1 & 1\\ -1 & -1\end{bmatrix}x(k)$$

b) Write short notes on the following:

i) Point transformation method

ii) Phase plane method

7. a) Consider the closed loop discrete control system as shown in figure.



Design a digital controller such that the dominant closed loop poles have a damping ratio $\xi = 0.5$ and settling time $t_s = 2$ sec for 2% tolerance band.

Take the sampling period as T = 0.2 sec.