* R M - 7 7 8 1 / 1 0 0 *

RM-7781

B. E. - IV (Sem. VIII) (IC) Examination

May / June – 2010

Modern Digital Control Systems

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - 4 (Sem. 8) (IC)**

Name of the Subject :

☛ **Modern Digital Control Systems**

☛ Subject Code No. : **7 7 8 1** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Answer the **two** sections in **separate** answer books.
(3) Use of non programmable calculators is allowed.
(4) Assume suitable data if required.
(5) Black figures to the right indicate full marks.
(6) Draw neat diagrams and use mathematical expressions whenever required.

SECTION - I

1 (a) Find the z transform of the function f (t) = e^t. **10**

(b) State final value theorem.

(c) How can we apply routh stability criteria for a system represented in z domain?

(d) Find $F(z)$ if $F(s)=\frac{1}{s+2}$

(e) Give the generalized state space representation in the matrix form for the system having n inputs and m outputs. The state vector $x \in \Re^p$.

2 (a) Prove that the stability requirements the poles of the z transform transfer function of the system must lie on the unit circle in the complex z plane. **10**

(b) Show that **10**

$$Z\left(\sum_{h=0}^{k} x(h)\right) = \frac{1}{1-z^{-1}} X(z)$$

$$Z\left(\sum_{h=0}^{k-1} x(h)\right) = \frac{z^{-1}}{1-z^{-1}} X(z)$$

(c) Obtain the z transform of k^2. **5**

OR

2 (a) Discuss the controllability of the system in state space and also derive necessary condition for it. **10**

(b) Discuss about quantizing and quantization error. **10**

(c) Obtain the block diagram for the pulse transfer function system (a digital filter) **5**

given by $\frac{Y(z)}{X(z)} = G(z) = \frac{2-0.6\ z^{-1}}{1+0.5\ z^{-1}}$

3 (a) Derive the expression for the state transition matrix. **8**

(b) Prove the final value theorem for z transformation. **7**

SECTION - II

4 (a) Answer the following questions :

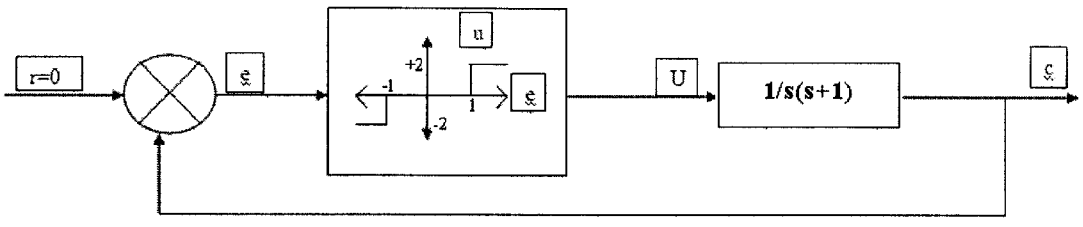
(i) What do you mean by an autonomous system? **2**

(ii) Explain the phenomenon of jump resonance. **4**

(iii) Explain the stability of limit cycles with the help of Vander Paul's Equation. **4**

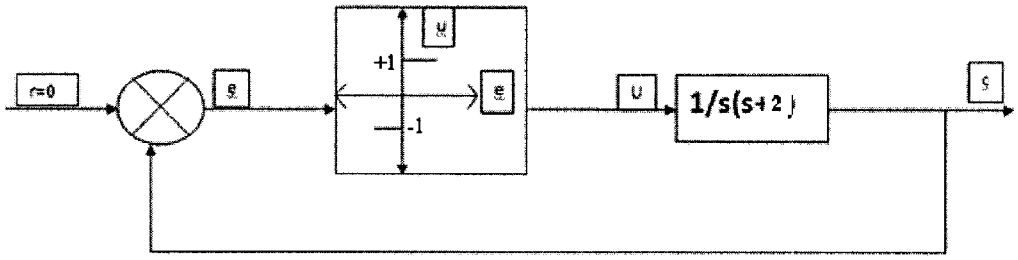
(b) A non-linear system having the non-linear element as a relay with dead zone is shown below. Draw the phase trajectory using isocline method and comment on the stability. **10**

Assume the initial condition as $(x, \dot{x}) = (1,0)$



OR

(b) A non-linear system having the non-linear element as a relay is shown below. Draw the phase trajectory using isocline method and comment on the stability. Assume the initial condition as (x,x) = (0.5,0) **10**



5 (a) Draw the phase trajectory using delta method for the given system. **10**

Assume the initial condition as $(x, \dot{x}) = (1,0)$

$$\ddot{X} + \dot{X} + X^3 = 0$$

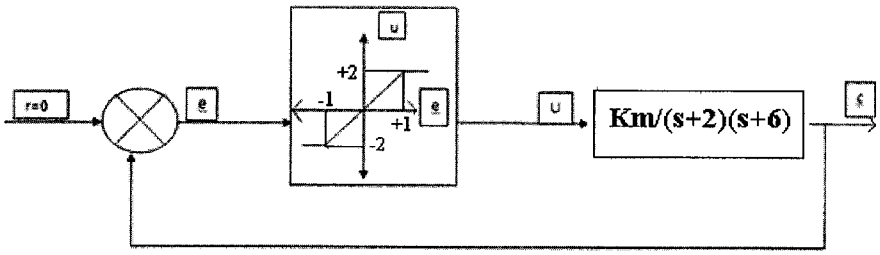
OR

(a) Draw the phase trajectory using delta method for the given system. **10**

Assume the initial condition as $(x, \dot{x}) = (1,0)$

$$\ddot{X} + |\dot{X}| \dot{X} + 4X = 0$$

(b) Obtain the linearised model of the following system using Harmonic linearization. Using the linearised model, discuss the stability of the system. **12**



OR

(b) (i) Obtain the Describing Function of the Hysteresis non-linearity. **8**

(ii) State all the Liapunov stability theorems. **4**

6 (a) Explain stability analysis using describing function method. **4**

(b) Check if the following Quadratic form is positive definite. **4**

$$X1^2 + 5X2^2 + X3^2 - 4X1X2 + 2X2X3$$