* R M - 7 7 6 5 / 1 0 0 *

RM-7765

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

May / June – 2010

Advance Control System

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) (Ele.)**

Name of the Subject :

☛ **Advance Control System**

☛Subject Code No. : **7 7 6 5** ☛Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Attempt **all** questions.

(3) Answer to the **two** sections must be written in **separate** answer book.

(4) Question 1 and 4 are **compulsory** questions.

(5) Assume **necessary** data and give sketches whenever **necessary**.

(6) Extreme **right** figures indicate full marks of the questions.

1 (a) Attempt all questions. (each question carries one mark) **10**

(i) Identify Nonlinearity of Fig.1

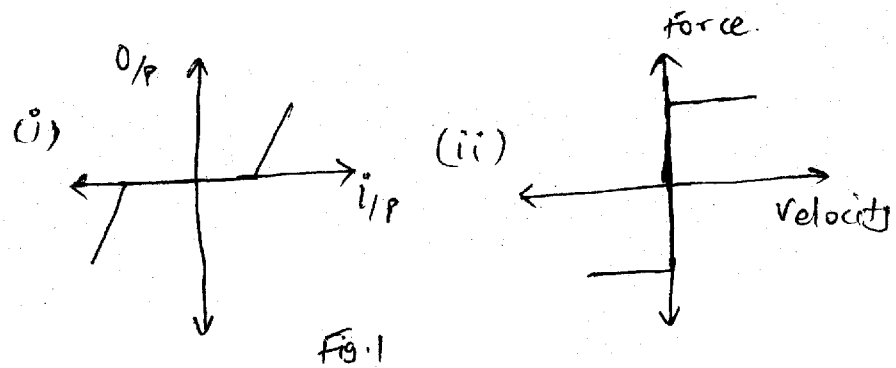


Fig.1

(ii) Define dual L/P describing function.

(iii) The jump resonance phenomenon exists in both linear and non linear systems.

(iv) Explain non analytic non linearity with one example.

(v) Define phase portrait.

(vi) What do you mean by equilibrium points?

(vii) What is limit cycle in terms of non linear system?

(viii) What do you understand by international non linearity? Give one example if any.

(ix) Describe limitations of describing function.

(x) Limit cycle corresponds to the sinusoidal oscillations of constant magnitude and constant frequency (True/False).

(b) Obtain the describing function for the on-off controller with dead-zone and hystressis shown in figure 2. **10**

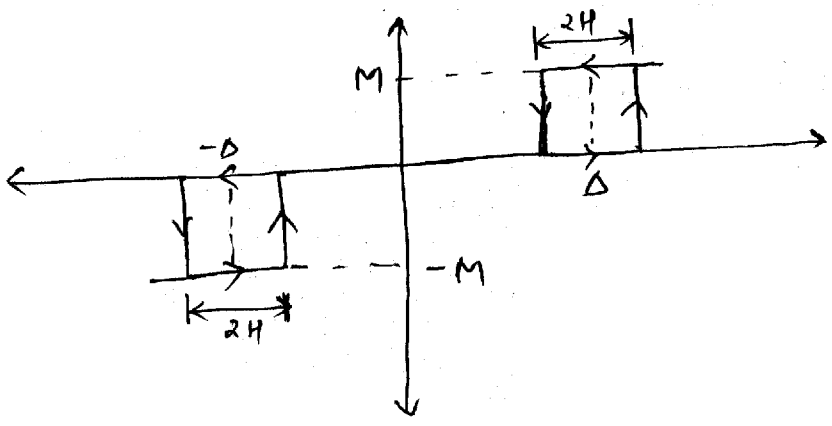


Fig. 2

2 (a) Explain data method for the construction of the phase plane trajectory and infer the stability of the system given by $\ddot{X} + 4\dot{X} + 4X = 0$ given $X(0) = 1$ and $\dot{X}(0) = 1$. **9**

(b) Explain the isoline method for the construction of phase plane trajectories. **6**

OR

2 (a) Explain Jump Resonance. **5**

(b) Draw the phase plane trajectories for the system $\ddot{X} + 0.5\dot{X} + 0.2X^2 = 0$ using Pell's method and starting at the point $X(0) = 5$ and $\dot{X}(0) = 2$.

3 (a) Explain how the describing function techniques can be used for stability analysis of non linear control system. **5**

(b) Consider the system shown below in Figure 3. Examine for the possible limit cycle oscillation in the system and if the limit cycle is predicted obtain its magnitude and frequency. **10**

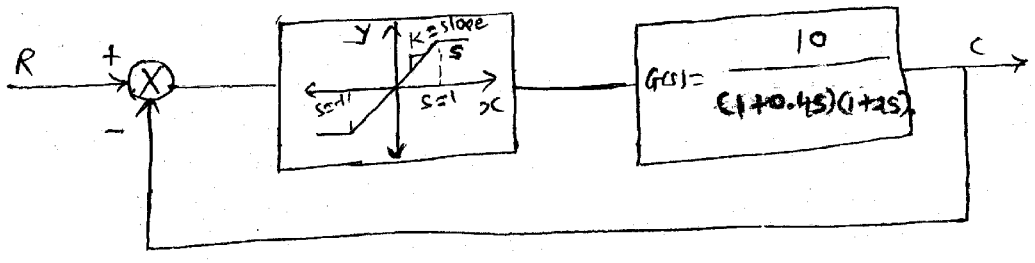


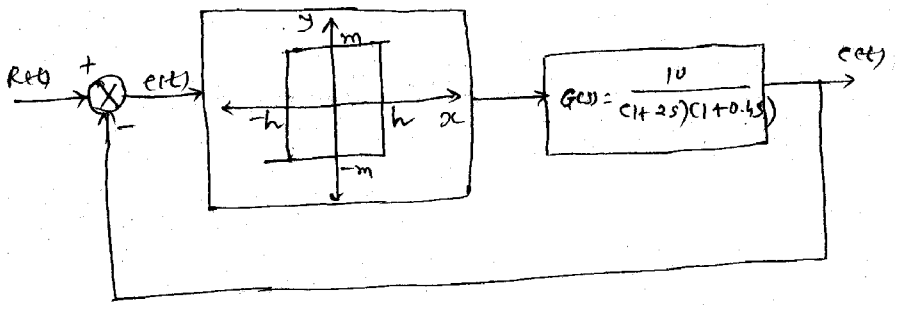
Fig. 3

OR

3 (a) A unity feedback system has a relay type non linearity with hystressis in the forward path as shown in figure 4 in cascade with a linear system having transfer G(S). Obtain the describing function N(E) for the relay with hystresses. **10**

(b) Plot the locus of $-\frac{1}{N(E)}$ for $m=1.0$ and $h=0.1$. **4**

(c) Examine the stability of the system and determine the amplitude and frequency of the limit cycle if any. **2**



SECTION - II

4 (a) Using bilateral transformation and Routh's stability criteria, comment on the stability of a system whose characteristic equation is **6**

$$P(z)=z^4-1.2z^3+0.07z^2+0.3z-0.08=0$$

(b) Answer the following in short. **6**

(i) Define 'Z' transform mathematically.

(ii) The inverse of sampling operation is _____ operation.

(iii) Check the stability of $u(k)=0.5\,\mu(k-1)-0.3\mu(k-2)$.

(iv) Define pulse transfer function.

(v) The location of closed loop zeroes of a discrete time system does not affect its absolute stability. Justify whether true or false.

(vi) IAE has full form _____ and mathematically IAE = _____.

(c) Consider the discrete time unity feedback system whose transfer function is 8

$$G_{ho}G(z) = \frac{k(z+0.717)}{(z-1)(z-0.368)},\ T = 1 \text{ sec}$$

Sketch the root locus for $0 \le k < \infty$. Also find the value of 'K' so that the system is marginally stable.

5 (a) Attempt any **three** : **9**

(i) $x(t) = \sin(at)$

(ii) $x(t) = t^2$

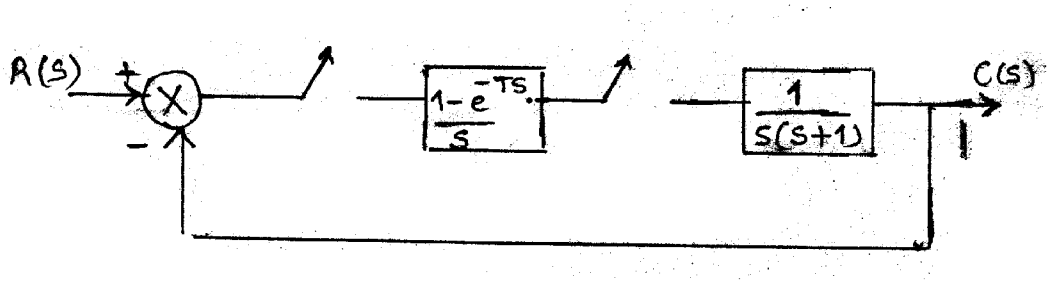
(iii) $x(k) = b^{-k}$, k is constant

(iv) $X(s) = \frac{2}{s(s+2)}$

(b) Discuss digital control system with complete block diagram showing all the signals at each stage of the block diagram. **6**

OR

(b) Obtain the pulse transfer function $\frac{C(z)}{R(z)}$ for the following closed loop system. **6**



6 (a) A unity feedback system has forward path transfer function $G(s)=\frac{K}{S(s+\alpha)}$ For the system initially at rest and with a unit step excitation. **8**

(i) Taking K as constant, determine the value of α which minimizes the integral square error

(ii) Taking α as constant, determine the value of k which minimizes the integral square error.

(b) Consider the difference equation **7**

$$X(k+2)-1.368X(k+1)+0.368X(k)=0.368u(k+1)+0.264u(k)$$

where $x(K)$ is the output and $x(K)=0$ for $k \le 0$ and $u(k)$ is the input, where $u(k)=0$ for $k<0$ $u(0)=1$ and $u(1)=u(2)=0.214$, $u(k)=0$ for $k \ge 3$.

Determine the output $x(k)$.

OR

6 (a) Show how the right half the left half planes and the imaginary axis of 'S' plane are mapped into the 'Z' plane. Hence show the constant frequency and constant damping root loci. **7**

(b) Find the inverse 'Z' transform of following :

(i) $x(z) = \dfrac{2z^2 - 1.5z}{z^2 - 1.5z + 0.5}$

(ii) $x(z) = \dfrac{10}{(z-1)(z-2)}$