YMCA UNIVERSITY OF SCIENCE & TECHNOLOGY, FARIDABAD
B.Tech 5th Semester Examination
Non Linear Control Systems
Paper: EIC-303,Scheme-2010

Note: Question1 is compulsory. Attempt four questions from PART-II. Assume missing data. Attempt the questions in sequential order preferably.

PART -1

Q1(a) What is the set of all values of z for which X(z) attains a finite value. (2)

(b) How Z and Laplace transform are related? (2)

(c) Write the state model of nth order system. (2)

(d) What are the advantages of state space modelling using physical variable? (2)

(e) Give a brief explanation of Lyapunov's 2nd method for proving stability of nonlinear dynamic systems. (2)

(f) Define controllability and observability. (2)

(g) What is similarity transformation? (2)

(h) Discuss backlash with example. (2)

(i) Find the Z transform x(1)= 2, X(4) = -3, X(7) = 8
And all other samples are zero. (2)

(j) How to find out isoclines for a system? (2)

PART -11

Q2(a) Obtain the describing function of On-Off non linearity. (6)

(b) What are the difficulties in non linear modelling and control? (4)

Q3(a) Consider a system described by equation (6)

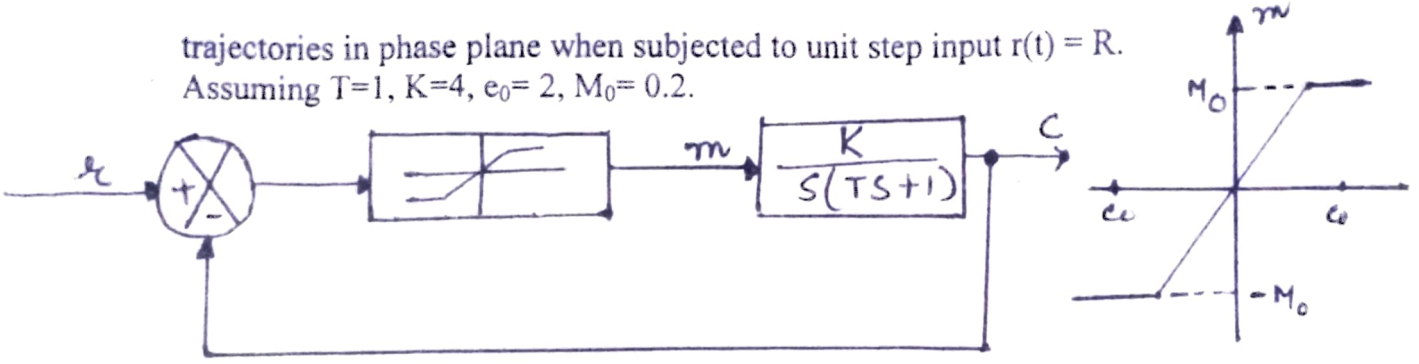
$$\ddot{x} + \dot{x} + x^3 = 0$$

Given that initial condition, X(0)=1, $\dot{X}(0)$= 0,construct the trajectory starting at initial point. Use delta method.

(b) Describe the limitations of describing function method. How it is used to find stability? (4)

Q4(a) Fig. shows a control system with saturation non linearity. The input output curve is shown in fig. Assuming that system is initially at rest, construct the (6)

trajectories in phase plane when subjected to unit step input r(t) = R. Assuming T=1, K=4, e_0= 2, M_0= 0.2.



Q4(b) Explain the procedure to find the pulse transfer function of a system. (4)

Q5(a) The transfer function of the system is given below: (5)

$$\frac{Y(s)}{u(s)} = \frac{3s^2 + 2s + 7}{s^3 + 5s^2 + 12s + 5}$$

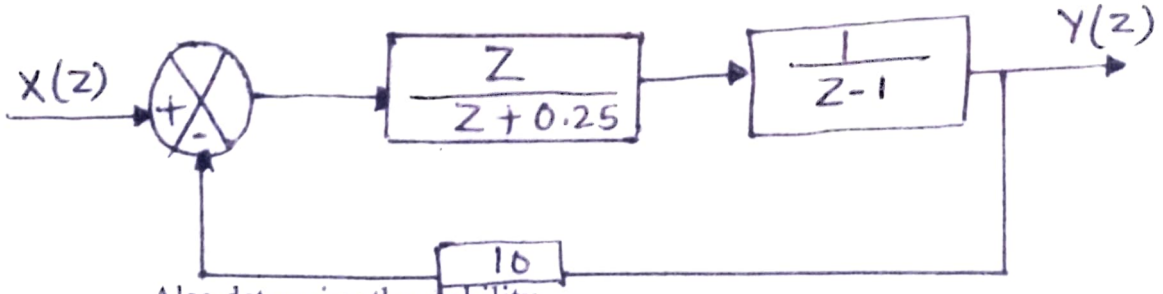
Express in CCF. Draw a state diagram and state matrix.

(b) Obtain the state model of the armature controlled DC motor, where E_a is the terminal voltage, Ra and La are the resistance and reactance of armature winding. L_f is the field reactance, i_f the field current, w is the angular velocity. (5)

Q6(a) Find the controllability of system described by the state equation (5)

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 3 \end{bmatrix} u$$

(b) Determine the Z transform function for the following system. (5)



Also determine the stability.

Q7(a) Discuss model reference adaptive system. (5)

(b) Using Lyapunov stability determine the stability of equilibrium state of system $\dot{X}$= AX with (5)

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