(Following Paper ID and Roll No. to be filled in your answer book)

Paper ID: Roll No | | | | | | | | | |

M.Tech
FIRST SEMESTER EXAMINATION, 2008-2009
ADVANCED CONTROL SYSTEM
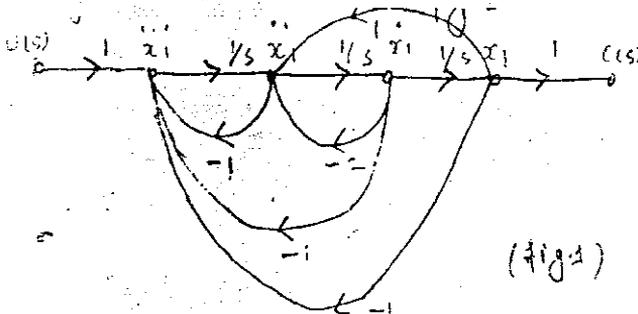
Time: 3hrs.   *Max. Marks:100*

Note: Attempt any Five questions. All questions carry equal marks.

Q1.(a) Derive the state variable formulation for an armature controlled dc motor.

(b) A feedback system is represented by a signal flow graph as shown in fig.1.

(fig.1)

(i) Construct the state model of the system

(ii) Diagonalize the coefficient matrix A.

Q2.(a) A feedback system has a closed – loop transfer function :

$$\frac{c(s)}{R(s)} = \frac{10\ s(s+4)}{s(s+1)\ (s+3)}$$

Derive the state model from the realization diagram.

(b) Consider a state model

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} \cdot u$$

suggest a suitable transformation matrix to diogonalize th system matrix A.

Q3.(a) Obtain the response of the system whose state model is given by

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

where $XT(0) = [0 \quad 0]T$ and $u(t) = 0; t < 0 = e - t; t \geq 0$

(b) Derive the Gilbert's test for checking observability an controllability of the system.

Q4.(a) Determine the system in fig.2 for controllability and observability
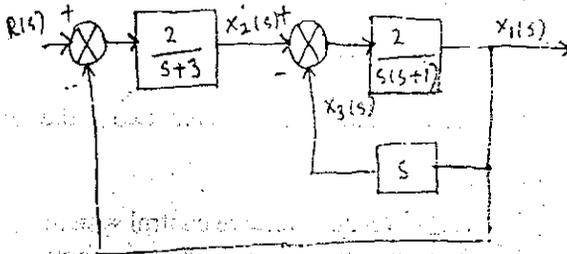
(b) What are the singular points? Derive the singularities for th system given by
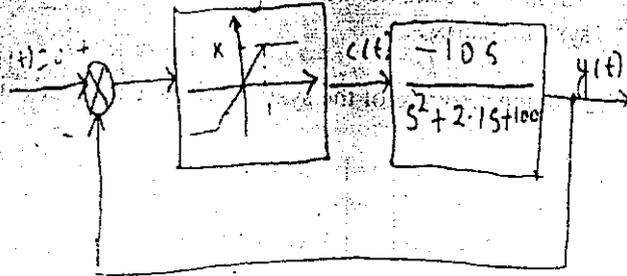
$$\dot{x}_1 = x_2$$
$$\dot{x}_2 = -10 \sin x_1 - x_2$$

Also draw the corresponding phase portraits.

Q5. (a) Define the limit cycle. How the existence of limit cycles can be predicted? Explain with a suitable exam.

(b) Consider the system as shown in figure.3

Predict the existence of limit cycle.

Q6. (a) Discuss the various common non – liniorities. Also derive the describing function for dead zone in combination with saturation.

(b) Check if all the roots of the given characteristics equation lie within the unit circle.

$$\Delta(z) = z^4 + 9z^3 + 7z^2 + 6z + 1$$

Q7. Write short technical notes on any two of the following :

(a) Robust control system

(b) Model Reference Adoptive control system

(c) Theorems and properties of Z – transform

(d) Circle and popov criterion