Student Exam No:-__________

GANPAT UNIVERSITY
M.TECH SEM-I (ELECTRICAL)
REGULAR EXAMINATION DEC-2013
3EE103:-ADVANCED CONTROL SYSTEM

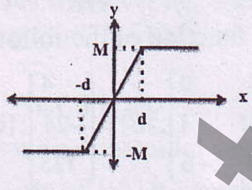
Time: 3 Hours **Total Marks:-70**

Instructions: - 1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

SECTION I

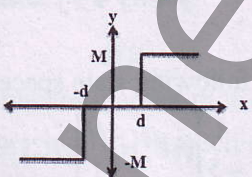
Q-1 **A** What are the assumptions in describing function analysis? [5]

B Derive the describing function for the following nonlinearity. [7]



OR

Q-1 **A** Derive the describing function for the following nonlinearity. [7]



B How to find a linear approximation of nonlinear system? [5]

Q-2 **A** How to analyze the stability of nonlinear system using describing function? [6]

B Examine the asymptotic stability of the following non-linear system by proposing a Liapunov's function. [5]

$$\dot{x}_2 = x_1 - x_2 - x_2^3$$

OR

Q-2 **A** Consider the plants as given below. Generate the phase plane solution and describe the nature of the trajectories. [5]

$$\dot{x}_1 = x_2,$$
$$\dot{x}_2 = x_1$$

B Consider the plants as given below. Examine their asymptotic stability using trace of the [A] matrix and confirm the result using Eigen values. [6]

$$A_1 = \begin{bmatrix} 0 & 1 \\ -4 & -4 \end{bmatrix}; \ \{x_0\} = \begin{Bmatrix} 0 \\ 1 \end{Bmatrix}$$

Q-3 **Attempt any two.** [12]

A Explain the energy-stability correlation.

B Explain liapunov stability theorem.

C Derive the solution of the state equation of non-homogeneous system and explain what is homogeneous and forces solution.

SECTION II

Q-4 **A** For given system, design a feed-back controller to place the following poles. **[7]**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}; \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}; \quad \text{Poles: } -1 \pm j3,\ -4$$

B Check for the observability of following system. **[3]**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}; C = [10 \quad 0 \quad 0]$$

C What is stabilizability? **[2]**

OR

Q-4 **A** Find the equivalent transfer function of the following state space model. **[6]**

$$[A] = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -4 & -6 \end{bmatrix}; [B] = \begin{bmatrix} 4 \\ -24 \\ 125 \end{bmatrix}; [C] = [1 \quad 0 \quad 0]; [D] = [0]$$

B Obtain the diagonal canonical form for the following differential equation. **[6]**

$$\ddot{y} + 8\dot{y} + 9y = 4\ddot{u} + 3u$$

Q-5 **A** Find the output response of following state space model. **[7]**

$$[A] = \begin{bmatrix} 0 & 1 \\ -4 & -5 \end{bmatrix}; [B] = \begin{bmatrix} 0 \\ 1 \end{bmatrix}; [C] = [-26 \quad -26]; [D] = [6]$$

B Find the controller canonical form for given transfer function. **[4]**

$$G(s) = \frac{(s^2 + 26s + 160)}{(s^3 + 17s^2 + 92s + 160)}$$

OR

Q-5 **A** Check for the state controllability and output controllability of given system. **[5]**

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}; B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix}; C = [0 \quad 0 \quad 1];$$

B Prove that state controllability is the necessary and sufficient condition for placing the arbitrary poles. **[6]**

Q-6 **Attempt any two** **[12]**

A Derive the condition for checking the controllability of state space model.

B Explain the invariance properties with respect to state space transformation.

C
1. Explain the advantages of state space approach over the classical approach of system analysis and design.
2. What is limit cycle point? With example explain the stability of limit cycle point.

END OF PAPER

Best of Luck