

NR/R09

Code No: A0705, C3704, C7501, C5601

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I Semester Examinations, March/April-2011

ADVANCED CONTROL SYSTEMS

(COMMON TO ELECTRICAL POWER SYSTEMS, CONTROL ENGINEERING,  
CONTROL SYSTEMS, POWER SYSTEM HIGH VOLTAGE)

Time: 3hours

Max. Marks: 60

Answer any five questions  
All questions carry equal marks

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1. The feed forward function of unity feed back system is  $G(s) = \frac{1.06}{s(s+1)(s+2)}$ . Design a compensator for the system to increase the static velocity coefficient  $K_v$  to about  $5 \text{ sec}^{-1}$  without appreciably changing the location of the dominant closed-loop poles. [12]

2. (a) Explain the Liapunov's stability analysis of the dynamical systems.

(b) Determine the stability of the origin of the following system:

$$\dot{x}_1 = x_1 - x_2 - x_1^3$$

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

[12]

3. Construct a Liapunov function of the following system

$$\dot{x}_1 = -x_1 + x_1^2 x_2$$

$$\dot{x}_2 = -x_2$$

by use of the variable-gradient method. Then determine the stability of origin of the system.

[12]

4. (a) Explain the concept of limit cycle and jump responses.  
(b) Derive the equation for the describing function  $N$  for the hysteresis nonlinearity shown in Fig. P4.

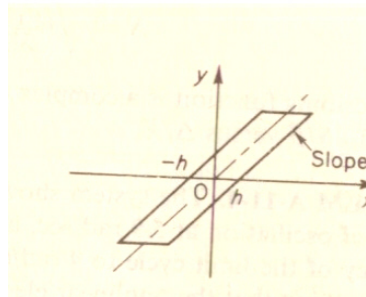


Fig. P4 Input-output characteristics curve for hysteresis nonlinearity. [12]

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5. (a) Explain the isocline method for construction of phase –plane portrait.  
 (b) Determine the locations and types of singular points of the nonlinear system described by

$$\dot{x}_1 = 0.3 - 0.1 x_1 + x_2 - 0.188 x_1^2 x_2 - 0.75 x_2^3$$

$$\dot{x}_2 = -0.25 x_1 - 0.1 x_2 + 0.047 x_2^3 + 0.188 x_1 x_2^2$$

[12]

6. (a) Explain the concept of complete state controllability and output controllability of continuous time systems.  
 (b) Consider the system given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} [u] \text{ and } [y] = \begin{bmatrix} 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Is the system completely state controllable and completely observable. [12]

7. (a) Explain the concept of second order eigen vector sensitivities for continuous time systems.  
 (b) Explain the mode observability structure of multi variable linear system. [12]
8. (a) Consider the system matrix is given by

$$A = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix}$$

Obtain the similarity transformation matrix P, which transforms the above system matrix into Jordan canonical form.

- (b) Explain the concept of first – order Eigen value sensitivities for continuous time systems. [12]

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