Code No: A0705, C3704, C7501, C5601 **NR/R09**

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 sec^{-1} with out 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.

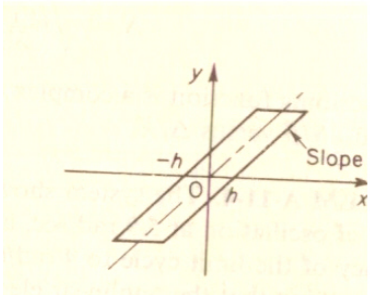

Fig. P4 Input –output characteristics curve for hysteresis nonlinearity. [12]

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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

$$\dot{X}_1 = 0.3 - 0.1X_1 + X_2 - 0.188X_1^2X_2 - 0.75X_2^3$$

$$\dot{X}_2 = -0.25X_1 - 0.1X_2 + 0.047X_2^3 + 0.188X_1X_2^2$$

[12]

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

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

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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