D 42506 (Pages : 3)

Name.............................

Reg. No..........................

SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION DECEMBER 2007

EE 04—703 CONTROL SYSTEMS—II

Time : Three Hours Maximum : 100 Marks

I. (a) Briefly explain the phenomena exhibited by non-linear systems that cannot be seen in linear systems.

(b) What are the basic assumptions made in describing function analysis ?

(c) Briefly explain the concept of stability in the sense of Liapunov.

(d) Check the definiteness of the following :—

(i) $V(x) = -x_1^2 - (3x_1 + 2x_2)^2$.

(ii) $V(x) = x_1 x_2 + x_2^2$.

(e) What is meant by controllability ?

(f) Check whether the system is completely observable.

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

$$Y = \begin{bmatrix} +1 & +3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

(g) What is meant by "Robust Control" ?

(h) Show that feedback does not reduce the sensitivity to variations in the parameters in the feedback path.

(8 × 5 = 40 marks)

II. (a) Briefly explain the Graphical method for constructing the phase plane trajectories using the isocline.

Or

Turn over

(b) Consider a non-linear system, where the input and output are related through the differential equation :

$$y(t) = x^2 \frac{dx}{dt} + 2x$$

obtain the describing function.

III. (a) Explain how Liapunov method is applied for the stability analysis of linear time invariant systems.

Or

(b) Investigate the stability of the following system using Liapunov's theorem :—

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x.$$

IV. (a) Show that, of a system is completely controllable, it is possible to place the closed-loop poles of the systems at any desired location in the s-plane.

Or

(b) A system is described by the following state space model :—

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -6 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u.$$

Design a state feedback controller such that the poles are moved to $-1 \pm j_1 -5$.

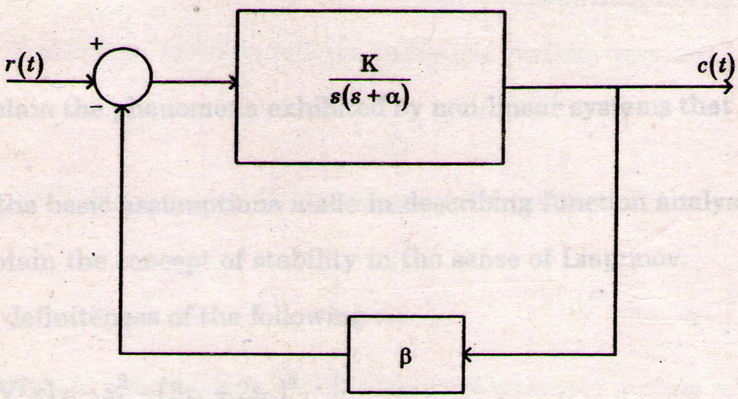
V. (a) For the system $G(s) = \dfrac{K}{s(s+a)(s+b)}$ the uncertainty ranges for the parameters K, a and b are as follows :

$$K = 10 \pm 2, \ a = 3 \pm 0.5, \ b = 4 \pm 0.2$$

Determine the stability of the system.

Or

(b) For the system nominal values of K = 10, $\alpha = 2$ and $\beta = 1$. Evaluate the sensitivities of the closed-loop transfer function and hence find the change in transfer function $(\Delta T(s))$ for 5% change in K.



(4 × 15 = 60 marks)