D 1224 (Pages : 2) Name.....

Reg. No.....

SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2009

EE 04 703—CONTROL SYSTEMS—II

(2004 admissions)

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

1. (a) Discuss the limitations of phase plane method of analysis of non-linear systems.

   (b) Show that the following non-linear system,

$$\dot{x}_1 = -x_1 + 2x_2, \dot{x}_2 = -2x_1 - x_2 + x_2^2$$

   is asymptotically stable in the region $V(x) = x_1^2 + x_2^2 \leq 1$.

   (c) State Popov's criterion.

   (d) Differentiate between asymptotic stability and exponential stability.

   (e) Define the terms controllability and observability.

   (f) List out the signficance of performance Index on the design of systems.

   (g) Distinguish between pole position sensitivity and KHN roct sensitivity.

   (h) What do you mean by robust control ?

($8 \times 5 = 40$ marks)

2. (a) Determine the describing function for a non-linear element characterised by the response $y = ar + br^3$ to a sinusoidal input signal $r(t) = R \sin wt$.

Or

   (b) Determine the region of stability for non-linear system

$$X^\circ = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ -2x_2^3 \end{bmatrix}$$

   where $x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. Take $V^\circ(X) = -\left(x_1^2 + x_2^2\right)$.

3. (a) Explain in detail about Shultz-Gibson variable gradient method.

Or

   (b) (i) Examine the stability of the system by Krasovskii's theorem $\dot{x}_1 = -x_1$

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

(8 marks)

   (ii) State and prove Krasovskii's theorem. (7 marks)

Turn over

4. (a) Design a state feedback controller for a discrete time system with the poles placed at $z = 0.25 \pm 0.25j$

$$x\,(\mathrm{K}+1) = \begin{bmatrix} 0 & 1 \\ -0.5 & 1 \end{bmatrix} x(\mathrm{K}) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(\mathrm{K})$$

and y [K] = [0.5 1] x (K).

Or

(b) Transfer function of a plant is given by $\mathrm{G}(s) = \dfrac{(s+3)}{s^3 + 7s^2 + 14s + 8}$. It is desired to place the observer poles at – 5, – 6, – 8. Design an observer for the plant.

5. (a) Explain in detail about direct kinematic problem.

Or

(b) Discuss in detail about the design of robust PID controllres.

(4 × 15 = 60 marks)

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