**D 51341** EE (Pages 2) Name.....

Reg. No.....



**SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, DECEMBER 2008**

EE 04 703—CONTROL SYSTEMS—II

(2004 Admissions)

Time : Three Hours Maximum : 100 Marks

*Answer* **all** *questions.*

I. (a) What is meant by "Equilibrium points" ?

(b) What is "Limit Cycle" ?

(c) Determine whether or not the following quadratic form is negative definite :

$$Q = -x_1^2 - 3x_2^2 - 11x_3^2 + 2x_1 x_2 - 4x_2 x_3 - 2x_1 x_3$$

(d) Compare the merits and demerits of Liapunov second method applied to stability analysis of non-linear systems.

(e) State the conditions for complete state controlability and observability.

(f) Comment on the selection of a quadratic performance index for the optimal control problems.

(g) State small game theorem.

(h) Explain what is "Robust Parametric stability".

(8 × 5 = 40 marks)

II. (a) Briefly explain the "DELTA" method of contribution of phase trajectory. (15 marks)

*Or*

(b) Obtain the describing function of Relay with Dead zone, and hence show that the describing function of an ideal relay is $\frac{4M}{\pi X}\underline{|0^\circ}$, where M is output magnitude and X is input magnitude.

(15 marks)

III. (a) Determine the stability of the system $\dot{x} = Ax$ where $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ by Liapunov's theorem and hence determine a suitable Liapunov function.

(15 marks)

*Or*

**Turn over**

(b) Using Krasouskii's theorem, show that the equilibrium state at origin is asymptotically stable in the large for the system :

$$\dot{x}_1 = -x_1$$

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

(15 marks)

IV. (a) A system has the following transfer function. Determine a state space model of the phase variable form and check its observability $G(s) = \frac{s^2 + 5s + 4}{(s+1)(s+2)(s+3)}$.

(15 marks)

*Or*

(b) Briefly explain the following :—

(i) Minimum tune control problem.

(ii) Minimum energy problem.

(iii) Minimum fuel problem.

(iv) State regulator problem.

(v) Tracking problem.

(5 × 3 = 15 marks)

V. (a) "One important property of negative feedback is the reduction in the sensitivity to variations in the parameters of the forward path". Comment on this.

(15 marks)

*Or*

(b) The transfer function of the forward path of a unity feedback system is :

$$G(s) = \frac{k(s+2)}{s(s+p_1)(s+p_2)}$$

where the ranges of the parameters $z$, $p_1$ and $p_2$ are as :

$$z = 2 \pm 0.2,\ p_1 = 5 \pm 0.4,\ p_2 = 8 \pm 1$$

Use Kharitonov's technique to determine the range of values of $k$ for which the system will be stable.

(15 marks)

[4 × 15 = 60 marks]