C 5456 (Pages : 2) Name.....

Reg. No.....

SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION JUNE 2010

EE 04 703—CONTROL SYSTEMS—II

(2004 Admissions)

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*

I. (a) Differentiate between "intentional" and "inherent" type of non-linearities.

(b) What do you mean by describing function ?

(c) Explain the second method of Liapunov's stability theorem.

(d) Explain popov's stability criteria.

(e) What is optimal control ?

(f) What is state regulator problem ?

(g) Explain the term sensitivity in Robust control systems.

(h) Explain the Direct Kinematics Problem.

(8 × 5 = 40 marks)

Part B

II. (a) A system is described by the following equation $\ddot{x} + \dot{x} + x^3 = 0$. Its initial conditions are $x_{(0)} = 1, \dot{x}_{(0)} = 0$. Construct its trajectory on the phase plane diagram.

Or

(b) Consider the third order system with a saturating amplifier shown in Fig. 1 having gain K in its linear region. Determine the largest value of gain K for the system to stay stable. What would be the frequency, amplitude and nature of the limit cycle for a gain of K = 3 ?

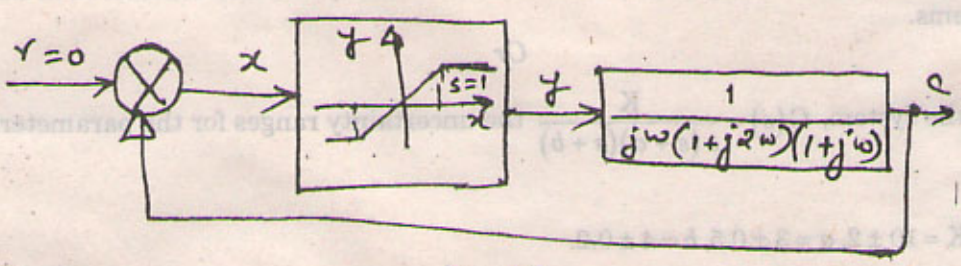

Fig (1)

(15 marks)

Turn over

III. (a) Determine the stability range for the gain m of the system shown below using Liapunov's second method.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & -2 & 1\\ -m & 0 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ m\end{bmatrix}u$$

where u is the input.

Or

(b) Consider a non linear system described by the equations :

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

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

Investigate the stability of equilibrium state using Krasovskii's method. (15 marks)

IV. (a) Given the system

$$\dot{X}=AX+Bu$$

where $A=\begin{bmatrix}1 & 0 & 0\\ 0 & 2 & 0\\ 0 & 0 & 3\end{bmatrix}$; $B=\begin{bmatrix}1 & 0\\ 0 & 1\\ 1 & 1\end{bmatrix}$.

Design a linear state variable feedback such that the closed loop poles are located at –1, –2 and –3.

Or

(b) A d.c. motor has a transfer function

$$G(s)=\frac{10}{s^2(s+1)(s^2+2s+2)}.$$

Determine whether this system is controllable and observable. (15 marks)

V. (a) Illustrate with an example, how uncertainties in the system are considered in Robust control systems.

Or

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

$K=10\pm2, a=3\pm0.5, b=4\pm0.2.$

Obtain the Kharitonov's four polynomials and hence comment on the stability of the system. (15 marks)

[4 × 15 = 60 marks]