234-08.

(REVISED COURSE)

(3 Hours)

CO-3442

[Total Marks : 100]
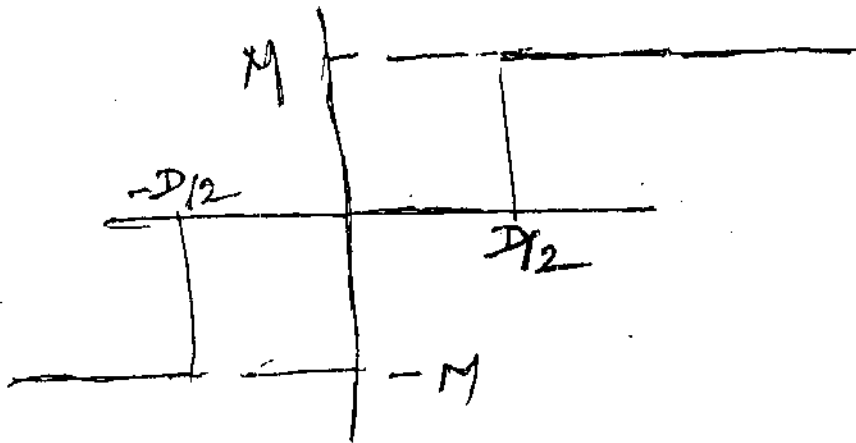
N.B.(1) Attempt any **five** questions.

(2) Assume **suitable** data if **needed**.

1. (a) The equation for Vander Pol's oscillator is given by— **10**

$$\ddot{y} + y - \mu (1 - y^2) \dot{y} = 0$$

where μ is a constant. Locate and identify the nature of singular points and plot corresponding nature of trajectories for $\mu > 0$, $\mu < 0$, $\mu = 1$.
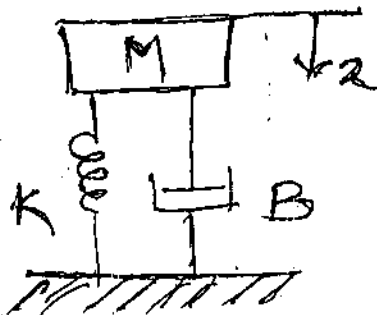
(b) Determine the describing function of ideal relay with delay. **10**

2. (a) Explain the Liapunov's theorem with examples. **10**

(b) Show that the Liapunov function for system shown below in given by **10**

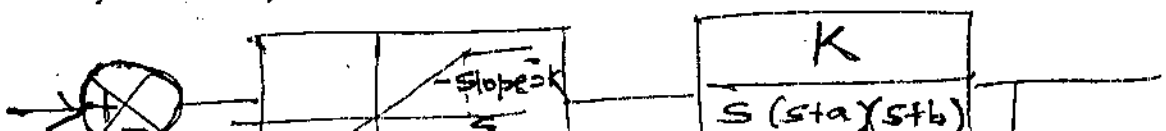$$V(x) = \frac{Kx_1^2}{2} + \frac{Mx_2^2}{2}$$ where x_1 is displacement and x_2 is velocity.

3. (a) The I/o characteristics of nonlinear device is given by— **10**

$$y = 4 \left(\frac{dx}{dt} \right)^2 + 6x + 3x^2 \frac{dx}{dt}$$

where x is input and y is output. Derive describing function of device.

(b) Consider the system shown. Use describing function technique to investigate the possibility **10** of Limit cycle in the system.

4. (a) Draw phase trajectory for the system defined by—

$$\ddot{x} + 3x + \dot{x} = 0$$

Using delta method Starting pt is (1, 0).

(b) Consider the second order system described by—

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

Determine the stability of the equilibrium state. Find out a suitable Liapunov function a well.

5. (a) If a system is defined by—

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

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

Comment on the stability of the system using Krasovskii method.

(b) Explain in detail the schemes of adaptive control.

6. (a) A unity feed back system has nominal characteristics equation—
$q(s) = s^3 + 3s^2 + 3s + 4 = 0$
The coefficients vary as follows—
$3 \le a_0 \le 5; \ 1 \le a_1 \le 3; \ 2 \le a_2 \le 3.$

(b) Determine the stability of following systems—

(i) $\ddot{x} + 2\dot{x}^2 + 2x = 0$

(ii) $\dot{x} = Ax$

where $A = \begin{bmatrix} -1 & -2 \\ 1 & -4 \end{bmatrix}.$

7. (a) Write short notes on —
   (i) Jump response
   (ii) Structured and unstructued uncertainty.

(b) Explain methods for improving ROBUSTNESS—Robust identification schemes.