S.E. Sem. IV (CBGS) E7RX → 02/06/2015
Principles of Control Systems

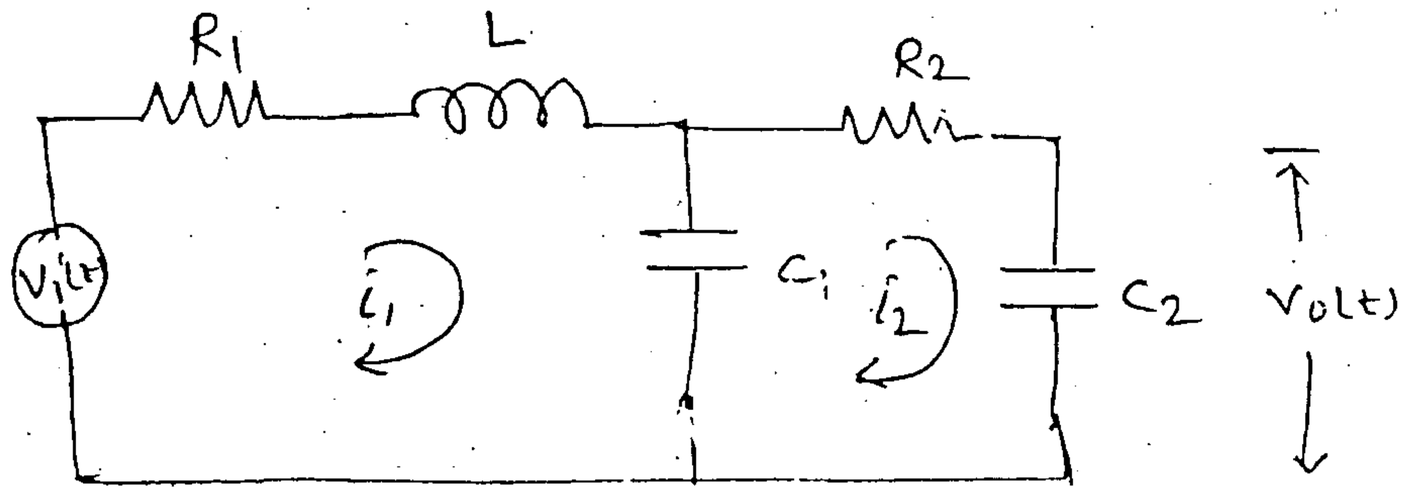
QP Code : **3531**

(3 Hours) [**Total Marks : 80**

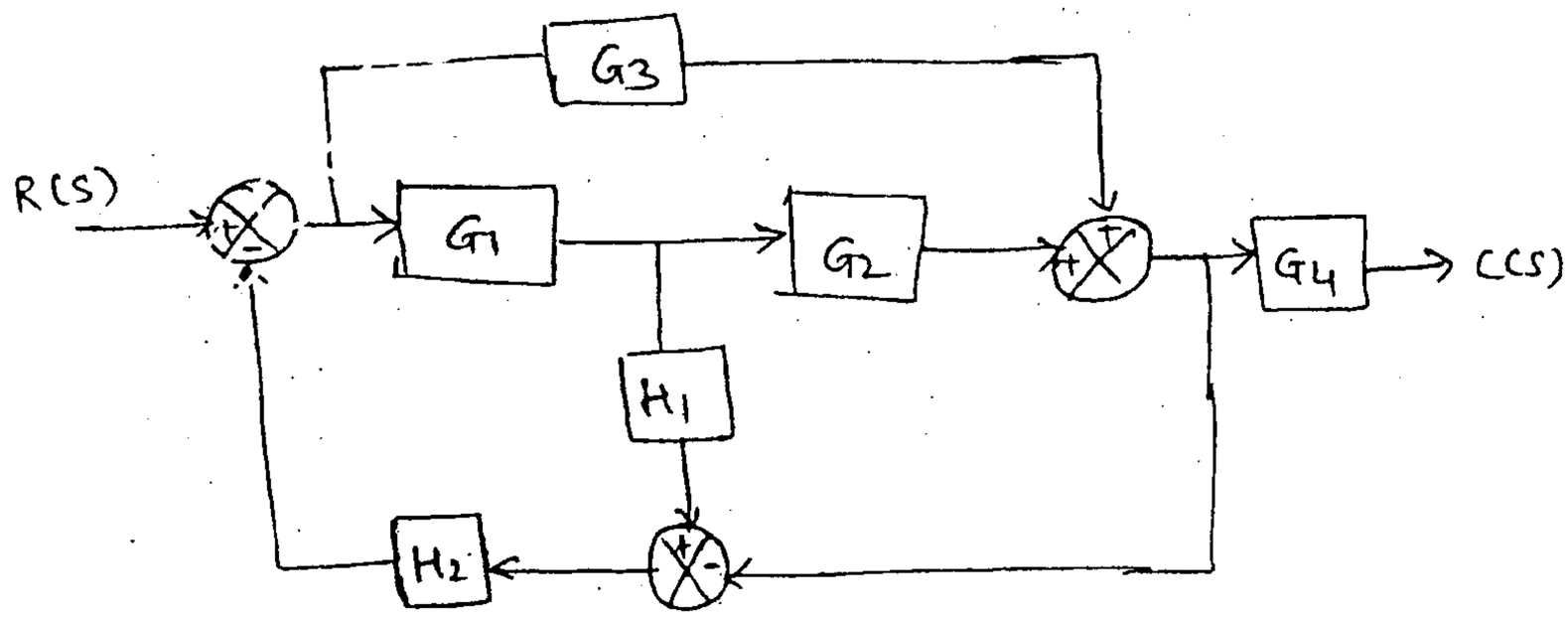
N. B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **three** questions from remaining questions.
(3) Assume suitable data if necessary.

1. Attempt any **four** :– **20**
   (a) Explain the effect of addition of pole and zero to the system.
   (b) Define gain margin and phase margin. Explain how these margins are used for stability analysis.
   (c) Differentiate open-loop and closed-loop systems.
   (d) Explain need of compensator.
   (e) State and prove properties of state transition matrix.

2. (a) Obtain the transfer function of the following electrical system. **10**



(b) Find the transfer function $\frac{C(s)}{R(s)}$ for the following system using block diagram reduction technique. **10**



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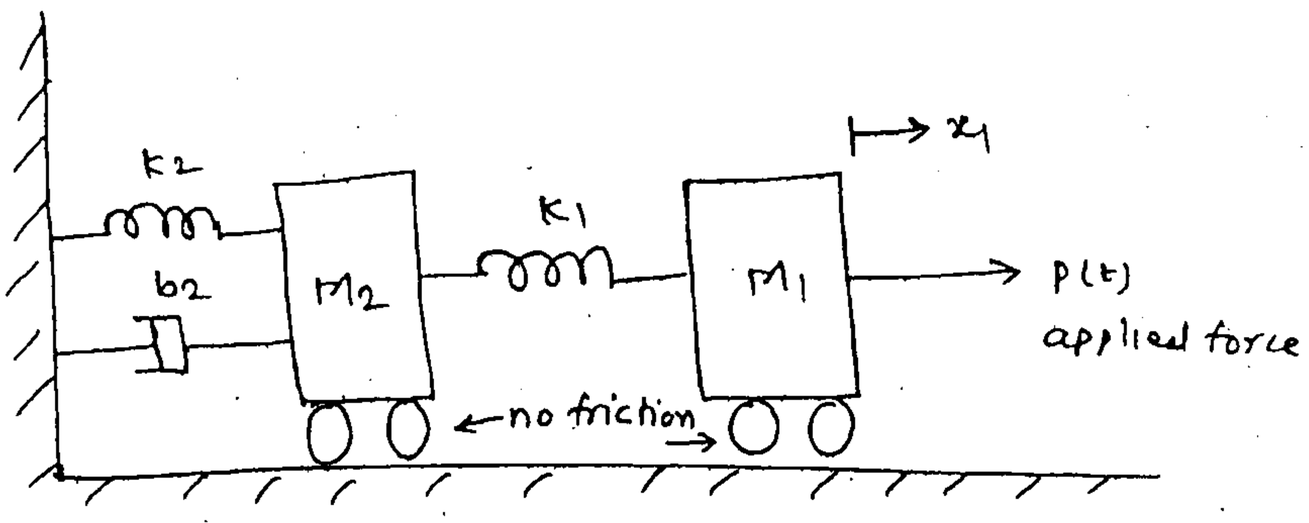
3. (a) Obtain the state space model for the following mechanical system 10



(b) Obtain the solution of the system described by 10

$$\dot{x}=\begin{bmatrix}0 & 1\\ -2 & -4\end{bmatrix}x+\begin{bmatrix}0\\ 2\end{bmatrix}u$$

4. (a) The open-loop transfer function of a unity feedback system is given by 10

$$G(s)=\frac{K}{(s+3)(s+5)(s^2+2s+2)}$$

Plot the root loci. Find the points where the root loci cross the imaginary axis

(b) Construct the bode plot for the following transfer function. Comment on stability 10

$$G(s)=\frac{100}{s^2(1+0.005s)(1+0.08s)(1+0.5s)}$$

5. (a) Check controllability and observability for the system described by 10

$$\dot{x}=\begin{bmatrix}0 & 6 & -5\\ 1 & 0 & 2\\ 3 & 2 & 4\end{bmatrix}x+\begin{bmatrix}0\\ 1\\ 2\end{bmatrix}u$$

$$y=[1 \quad 2 \quad 3]x$$

(b) Derive the relationship between time and frequency domain specifications of the system.

6. (a) Wrtie a short note on model predictive control 5
(b) Explain the features of P, I and D control actions 5
(c) Find the range of K for the system to be stable 5

$$s^4+7s^3+10s^2+2ks+k=0$$

(d) Describe the Mason's gain formula with an example. 5