BT-6/J07

Control System

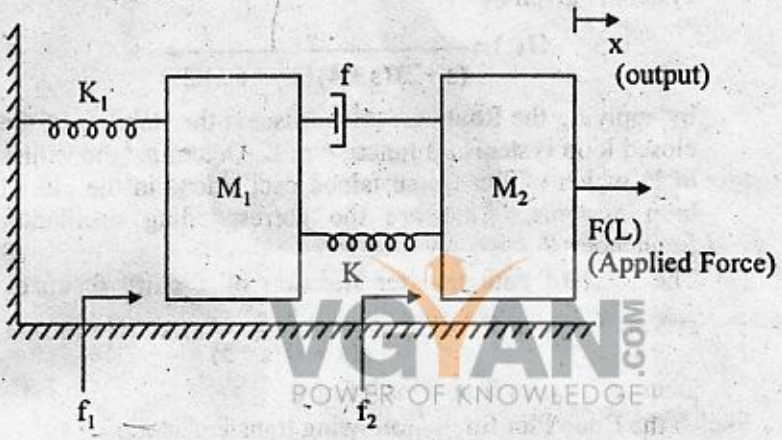
Paper : EE-304

Time : Three Hours] [Maximum Marks : 100

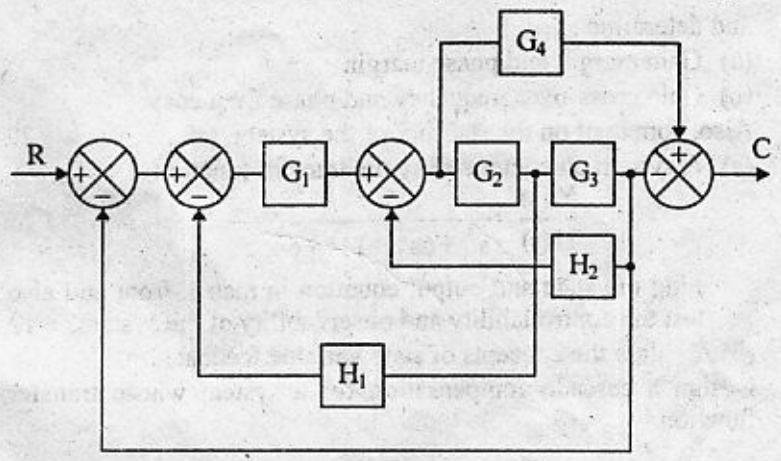
Note : Attempt any **FIVE** questions. All questions carry equal marks.

1. (a) What is a control problem ? Explain the basic control loop with an example. Explain the function of every element. 8

(b) Obtain the transfer function of the following mechanical system. 6



(c) Using block diagram reduction techniques, find the closed loop transfer function of the system given in block diagram. 6



2. (a) Explain the difference between feedback and non-feedback systems. Enumerate the benefits of feedback in control systems. 10

(b) Explain the term actuator. Briefly explain the working principles of various actuators. 10

3. (a) Explain the system specifications in time and frequency domain. Also explain their relationships. 10

(b) Obtain the expressions for steady state errors and error constants for unit step unit ramp and unit parabolic input for type 0, type 1, type 2 systems. 10

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

$$G(s)=\frac{k}{(s+2)(s+4)(s^2+6s+25)}$$

by applying the Routh-criterion, discuss the stability of the closed loop system as a function of K. Determine the values of K which will cause sustained oscillations in the closed loop systems. What are the corresponding oscillation frequencies ? 8

(b) The forward path transfer function of a unity feedback system is given by $G(s)=\frac{k}{s(s+4)(s+5)}$. Sketch the root locus as k varies from zero infinity. 12

5. Sketch the Bode Plot for the following transfer function :

$$G(s)=\frac{64(s+2)}{s(s+0\cdot5)(s^2+3\cdot2s+64)}.$$

and determine :

(a) Gain margin and phase margin

(b) Gain cross-over frequency and phase frequency.

Also, comment on the stability of the system. 20

6. (a) A system characterised by the transfer function

$$\frac{Y(s)}{U(s)}=\frac{2}{s^3+6s^2+11s+6}.$$

Find the state and output equation in matrix from and also test the controllability and observability of the system. 12

(b) Explain the concepts of state variable feedback. 8

7. Design a cascade compensation for a system whose transfer function is

$$G(s)=\frac{k}{s(1+0\cdot1s)(1+0\cdot001s)}.$$

to satisfy the following specifications phase margin $\geq 45^\circ$ velocity constant $k_v=1000\,sec^{-1}$. Sketch the Bode plot of uncompensated and compensated systems. 20

8. (a) Explain the difference between feed-forward and feedback control system. 10

(b) Explain Liapunov's criterion of stability. 10