

**BT-5/D-21**

**45112**

**CONTROL SYSTEM ENGINEERING**

**Paper–ECE-307**

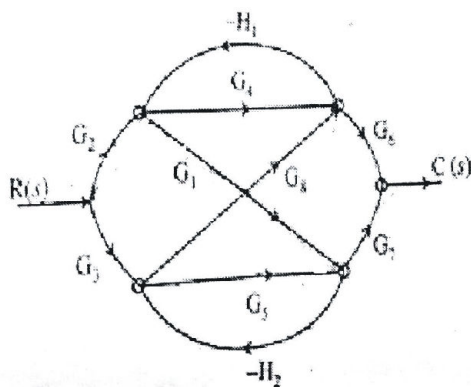
Time Allowed : 3 Hours]

[Maximum Marks : 75

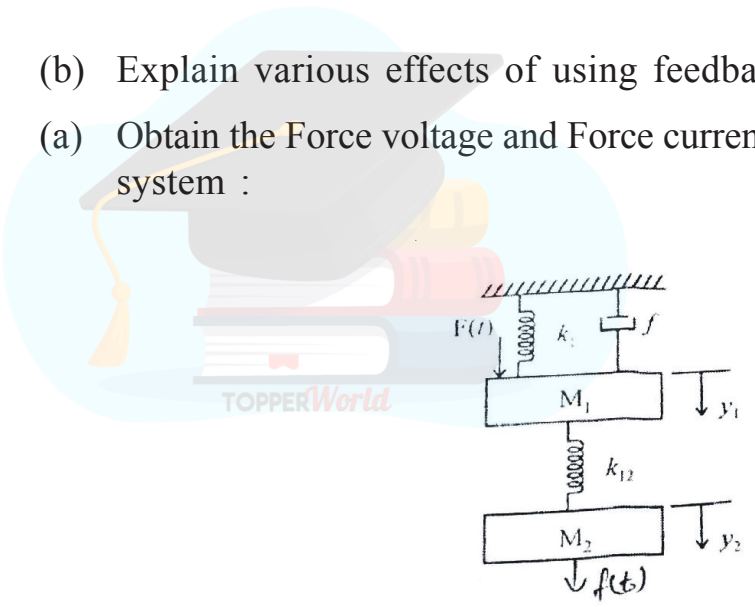
**Note** : Attempt **five** questions in all, selecting at least **one** question from each Unit.

**UNIT-I**

1. (a) Fig. 1 gives the signal flow graph of a control system with one input  $R(s)$  and one output  $C(s)$ . Find  $C(s)/R(s)$  using Mason's gain formula: 10



- (b) Explain various effects of using feedback in Control system. 5
2. (a) Obtain the Force voltage and Force current analogy of the given Physical system : 10



- (b) Draw and explain the working of Stepper motor. 5

## UNIT-II

3. Discuss the Routh Hurwitz criterion for determining the stability of control system and calculate the range of K for stable operation of following characteristics equation: 15

(a)  $s^3 + 3ks^2 + (k + 2)s + 4 = 0$ .

(b)  $s^6 + s^5 + 2s^4 + 3s^3 + 7s^2 + 4s + 4 = 0$ .

4. Sketch the root locus plot for the system having open loop transfer function is given by :

$$G(S)H(S) = \frac{K}{s(s+6)(s^2+4s+13)} \quad 15$$

## UNIT-III

5. (a) Explain the correlation between Time and Frequency response. 10  
(b) State and explain Nyquist's criteria for stability. 5
6. Make Bode plot for unity feedback systems with following transfer function :

$$\frac{10(s+2)}{s(s+3)(s+5)(s+10)}$$

Determine gain margin and phase margin and comment on stability.

## UNIT-IV

7. Explain the concept of Controllability and Observability of a control system. Derive the necessary and sufficient conditions for the controllability and observability. Examine the controllability and observability for the system described by the state equation :

$$Y(s)/U(s) = \frac{(s+3)}{s^3+9s^2+26s+24} \quad 10$$

8. A unity feedback system has an open loop transfer function :

$$G(S) = \frac{K}{s(1+s)(1+0.2s)}$$

Design Phase-lag for the system which has velocity error constant  $K_v = 6 \text{ sec}^{-1}$  and phase margin =  $20^\circ$ . Also compare the crossover frequency of the compensated and uncompensated system. 15