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BT-5/D-21 45112

CONTROL SYSTEM ENGINEERING

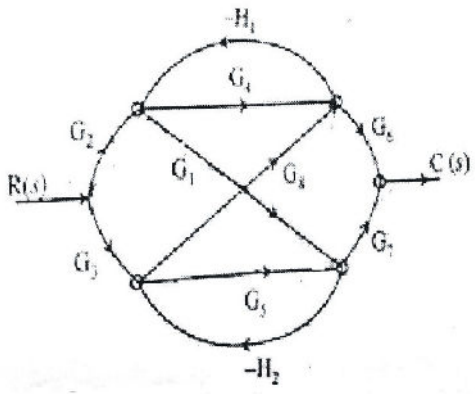
Paper–ECE-307

Time Allowed : 3 Hours] [Maximum Marks : 75

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

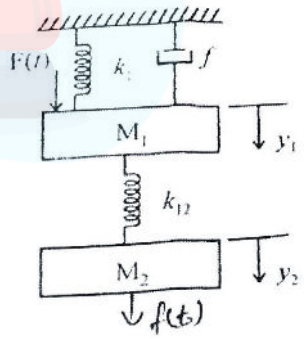
UNIT–I

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 :

$$G(S)H(S) = \frac{K}{s(s+6)(s^2+4s+13)}.$$ 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 oservability. Examine the controllability and observability for the system described by the state equation :

$$Y(s)/U(s) = \frac{(s+3)}{s^3+9s^2+26s+24}.$$ 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 $K_v = 6\ sec^{-1}$ and phase margin = 20°. Also compare the crossover frequency of the compensated and uncompensated system. 15