Time: 3 Hours **Total Marks: 80**

N.B: (1) Question No. 1 is compulsory.
(2) Attempt any three from the remaining questions.
(3) Figures to the right indicate full marks.
(4) Use Graph paper and semi log paper wherever necessary.

1. Attempt any four. 20
(A) Explain the effects of addition of open loop poles and zeros on root locus and transient response.
(B)Derive force to current analogy between mechanical and electrical system.
(C)Define the term damping ratio and explain its condition for stability.
(D Explain advantages of state space approach over conventional approach.
(E)Explain stability condition of Bode plot by using suitable diagram.

2. (A) Consider a unity feedback system with closed loop transfer function 10

$C(s)/R(s)=2/(s^2+3s+7)$. Find open loop transfer function. Show that the steady state error in the unit step response is 0.714.

(B) Determine the range of operating values of K so that system will be stable for the unity feedback system having characteristic equation as $S^4+5S^3+5S^2+4s+k = 0$ by Routh Hurwitz Method. 10

3. (A)) For the unity feedback system find the steady state error for the following test input of 2+6t for G(s)=1000(S+6)/(S+7)(S+10). 10

(B) The unity feedback system is characterized by an open loop transfer system G(s)= 10/(S+2)(s+5).Determine damping ratio, undamped natural frequency of oscillation. What is the percentage overshoot of the response to a unit step input. 10

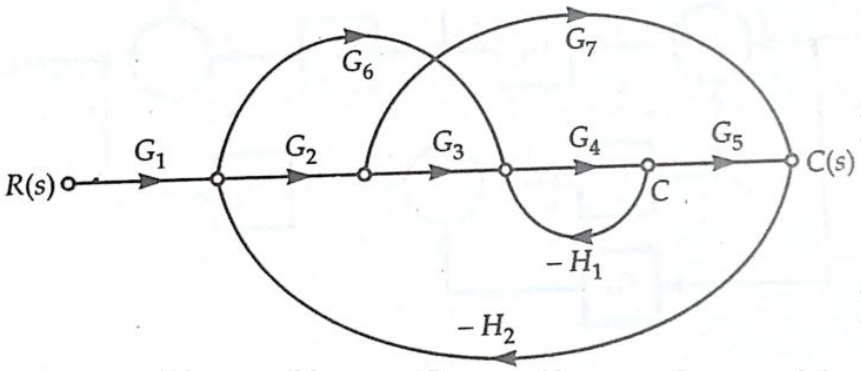
4. (A)Determine gain margin, phase margin, gain crossover frequency and phase cross over frequency for following transfer function: 10

$$G(s) = \frac{100(s+4)}{s(s+0.5)(s+10)}$$

(B) Sketch the root locus for unity feedback system for the transfer function given below: 10

$$G(s) = \frac{20}{S(S+2)(S+4)}$$

5. (A) Use Mason gain formula to find C(s)/R(s) of following signal flow graph: 10



(B) Represent the following system in state space in phase variable form and draw its state model. 10

$$G(s) = \frac{100(s+5)}{s(s+1)(s+4)}$$

6. Write notes on any two: 20

(A) Define Gain Margin, Phase Margin, Phase cross over frequency and gain Cross over Frequency in frequency domain
(B) Draw the block diagram of closed loop linear time invariant system and define its components.
(C) Write a short note on State Transition Matrix.
