

Time: (3 Hours)

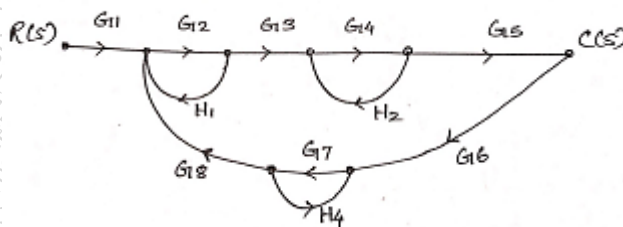
Total Marks – 80

- N.B.:-** (1) Question No.1 is compulsory.
 (2) **Attempt** any **three** questions out of remaining **five** questions.
 (3) Draw neat diagrams wherever it is necessary.

- Q 1. Answer any four of the following questions. 20
- A) Compare Open loop and Closed loop control system. 5
- B) Explain the following rules with suitable examples; 5
- (i) Blocks in series
- (ii) Blocks in parallel
- C) Explain Routh-Hurwitz criteria of stability with suitable example. 5
- D) What are the advantages of using state space analysis over classical control approaches? 5
- E) What is Nyquist stability criteria? 5
- Q 2 a) Obtain the differential equations and transfer function describing the mechanical system shown in fig. and also draw its electric network. 10



- Q 2 b) Find the transfer function $C(s)/R(s)$ for the signal-flow graph in figure. 10



- Q 3 a) Write a short note on: Time response specifications. **10**
- Q 3 b) The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine gain K, so that the system will have a damping ratio of 0.5. for this value of K, determine, T_s , T_p and M_p for a unit step. **10**
- Q 4 a) Define (i) State (ii) State variables (iii) State vector (iv) State space. How to obtain the state variable form from transfer function? **10**
- Q 4 b) Obtain the state representation in phase variable form of the following transfer function. **10**
- $$\frac{C(s)}{R(s)} = \frac{12s^2 + 42s + 158}{s^3 + 10s^2 + 56s + 158}$$
- Also draw state space model.
- Q 5 a) Sketch the root locus of a unity feedback system having $G(s)H(s) = \frac{K}{s(s+4)(s+10)}$ given, **10**
- also determine the value of K for $\xi = 0.5$.
- Q 5 b) Explain Angle and Magnitude condition. Also explain the steps to find intersection points of root locus with imaginary axis. **10**
- Q 6 a) For the unity feedback control system $G(s) = \frac{10}{s(s+1)(s+5)}$ Sketch the bode plot. Also **10**
- determine GM, PM, gain and phase crossover frequencies.
- Q 6 b) Discuss the stability of system using Nyquist plot for $G(s)H(s) = \frac{20}{s(s+4)(s-2)}$ **10**
