Hall Ticket Number:

Linear Control Systems

Time: **3 hours**   Max. Marks: **70**
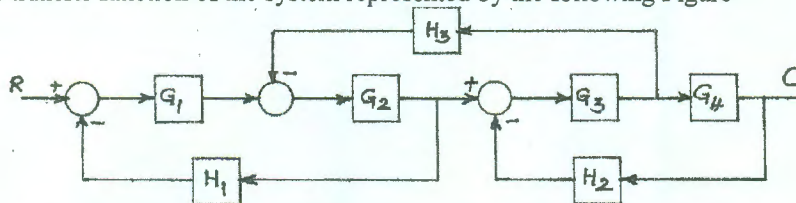
*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

Part-A (10 × 2 = 20 Marks)

1. What is the importance of feedback
2. List various types of control systems by giving one example for each
3. What is an order and type of the system
4. Define the damping ratio
5. Define corner frequency
6. State few importance of gain margin and phase margin
7. What is Nyquist Contour
8. Explain how do you obtain Gain and Phase margin from Bode plot
9. What is observability
10. List two properties of state transition matrix

Part-B (5 × 10 = 50 Marks)

11. a) Find the transfer function of the system represented by the following Figure   [6]

   b) Summarize the advantages of signal flow graph over block diagram reduction technique   [4]

12. a) Derive expressions for time domain specifications of a standard second order system to a step input.   [7]
   b) The characteristic equation of system is given below   [3]
$$s^5 + 6s^4 + 3s^3 + 2s^2 + s + 1 = 0$$
   Assess whether the system is stable or not using RH Criterion.

13. a) Sketch the Bode Plot for   [7]
$$G(s) = \frac{(1+100s)(1+s)}{(1+10s)(1+0.1s)}$$
   Assume unity feedback. Determine gain margin and phase margin
   b) Explain correlation between time and frequency response of a system   [3]

14. a) Explain the different steps to be followed for the design of lead compensator using Bode plot?   [5]
   b) Sketch the Nyquist Plot for a unity feedback system having open-loop transfer function given by G(s) = k/s(1+s)(1+2s)(1+3s) Determine the range of values of k for which the system is stable.   [5]

15. a) The system is represented by the differential equation   [6]
$$\ddot{y} + 5\dot{y} + 6y = u$$ Find the transfer function from state variable representation
   b) Explain any one method for evaluation of state transition matrix.   [4]

16. a) Write a short notes on Synchro Transmitter and receiver   [7]
   b) Explain the design procedure of PID controller   [3]

17. Answer any *two* of the following:
   a) Derive expression for peak resonance and bandwidth   [5]
   b) Explain the Nyquist stability criterion using suitable example   [5]
   c) Explain the significance of state Space Analysis   [5]