(3 Hours) [Total Marks : 100

N.B. : (1) Question No.1 is **compulsory.**
(2) Attempt any **four** questions from rest.
(3) Make any suitable assumption wherever required.
(4) Use of semilog paper or graph paper is necessary wherever applicable.

1. (i) Explain why is the phase Margin increased above that desired when designing a lag compensator. 5
(ii) Briefly describe the configuration of an observer. 5
(iii) Explain the region of stability on the z-plane 5
(iv) Explain the advantage of I-P controller over PI controller. 5

2. (a) Design the value of gain k for a gain margin of 12 dB in the unity feedback system if the open loop transfer function is 8

$$G(s) = \frac{k(s+2)}{s(s+3)(s+4)(s+6)}$$

(b) Given a unity feedback system with 12

$$G(s) = \frac{k(s+10)(s+11)}{s(s+3)(s+6)(s+9)}$$

Use frequency response method to design a lag compersator to yield Kv =1000 and 15% overshoot for the step response. Make any required second order approximation.

3. (a) Design a state variable feedback controller to yield a 20.8% overshoot and a settling time of 4 second for a plant. 15

$$G(s) = \frac{s+4}{(s+1)(s+2)(s+5)}$$

that is represented in cascade form.
(b) Compare the major difference in the transient response of an observer to that a controller. Why does this difference exist. 5

[TURN OVER

4. (a) Consider the plant $\dot{x} = \begin{bmatrix} 0 & 1 \\ -3 & -5 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ 10

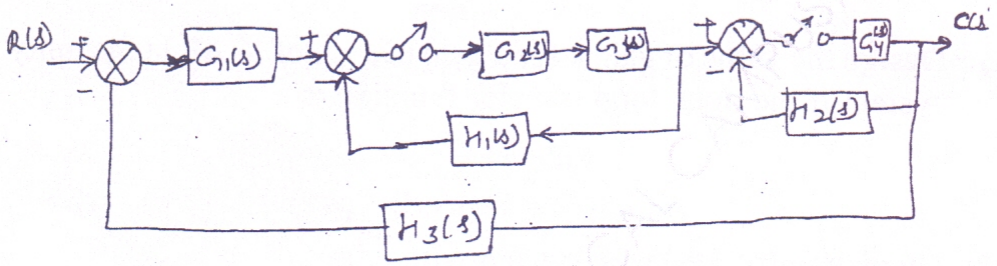
$y = [1 \quad 0]x$

Design a controller without integral control to yield a 10% overshoot and a settling time of 0.5 sec. Repeat the design with integral control.

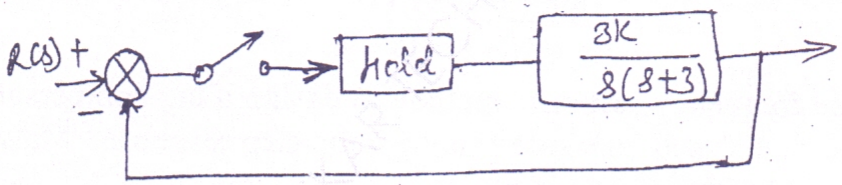
(b) Using partial fraction expanstion, find the z-transform for 10

G(s) if T = 0.5 sec $G(s) = \frac{s+4}{(s+2)(s+5)}$

5. (a) Find G (z) = C (z) / R (z) for the given block diagram if T = 0.3 sec 10



(b) Find the range of gain K to make the system shown in fig. below stable. 10



6. (a) Explain the logic behind the selection of PID controller in control system design. 10

(b) Explain the scan cycle of execution in PLC. 5

(c) Explain the use of start, stop and interlock circuit in PLC programming with the help of suitable small example. 5

7. (a) Properly explain in detail the Timer ON instruction and Move instruction of PLC with the help of two distinct example. 10

(b) Explain the importance and use of data file of PLC. 8

(c) Explain different type of addressing modes used in PLC. 2
