(3 hours) **Total Marks: 80**

N.B.: (1) Question No. 1 is compulsory.
(2) Solve any three questions from remaining five questions.
(3) Draw neat diagrams and assume suitable data wherever necessary. Justify your assumptions.

1. Attempt any **four**: 20

(a) Define i) Phase margin ii) Gain margin iii) Phase cross over frequency (ωpc) iv) Gain cross over frequency (ωgc)and state the conditions for stable system.

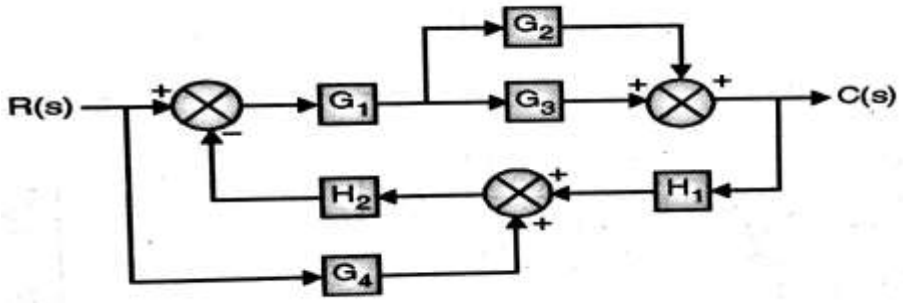
(b) Differentiate analog and digital control system.

(c) State and explain rules for constructing a root locus.

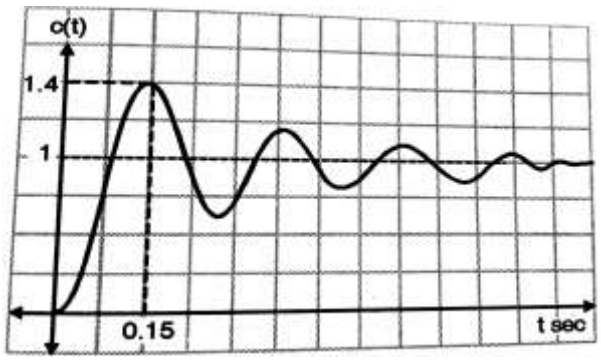
(d) Explain the need of compensation. State and explain different types of compensation techniques.

(e) Compare open loop and closed loop control system.

2. (a) Find the transfer function $\frac{C(s)}{R(s)}$ using Block Diagram Reduction Technique: 10



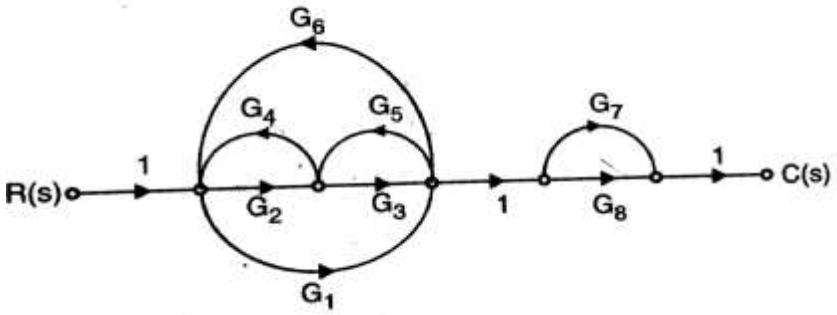
(b) For second order system the time response of a unit step is as shown below. Compute the resonant peak and resonant frequency. 10



3. (a) A feedback control system has open loop transfer function G(s) H(s) = $\frac{k}{s(s+4)(s^2+4s+20)}$. Plot the root locus for k=0 to ∞ indicate all the points on it. 12

   (b) Explain the realization of lag-lead compensator using electrical network. 8

4. (a) Obtain the overall transfer function from the signal flow graph: 10



   (b) Find the range of k so that the following system are stable using Routh's stability criteria: 10

   i) $S^4 + 7s^3 + 10s^2 + 2ks + k = 0$

   ii) $s^3 + 3ks^2 + (k+2)s + 4 = 0$

5. (a) For the transfer function given below G(s) H(s) = $\frac{48\,(s+10)}{s(s+20)(s^2+2.4s+1)}$ Find: 10

   i) Static position error coefficient
   ii) Static velocity error coefficient
   iii) Static acceleration error coefficient
   iv) Steady state error if the input to the system is unit step

   (b) For the unity feedback control system G(s)= $\frac{10}{s(s+1)(s+5)}$ sketch the Bode plot. Determine gain and phase margin. 10

6. (a) Explain Implementation of Digital controller in Temperature Control System. 10

   (b) Define i) Delay Time ii) Rise Time iii) Peak Time iv) Settling Time v) Peak overshoot 10