Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(IT-O)/SEM-4/EE-411/2012

2012
CONTROL SYSTEM

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct answers of the following : $10 \times 1 = 10$

i) In a signal flow graph, there are three loops having no node in common. Then the number of two non-touching loops are
   a) Two b) Three
   c) Four d) none of these.

ii) Negative phase margin indicates
   a) stable system
   b) marginally stable system
   c) unstable system
   d) under-damped system.

iii) 'All the elements in a row of a Routh assay are zero' indicates
   a) the system is unstable
   b) the system is marginally stable
   c) roots of characteristic equation are on far axis and stable
   d) the system is stable.

iv) The area under a unit impulse function is

a) infinity b) zero

c) unity d) none of these.

v) The system represented by its transfer function has some poles lying on imaginary axis of S-plane. The system is

a) unconditionally stable b) conditionally stable

c) unstable d) marginally stable.

vi) The root loci are

a) straight lines between poles and zeros

b) continuous curves between poles and zeros

c) continuous curves starting from poles or zeros and ending at infinity

d) any of these.

vii) In terms of Bode plot, the system is stable if

a) both gain margin and phase margin are positive

b) both gain margin and phase margin are negative

c) gain margin is positive, but phase margin is negative

d) gain margin is negative, but phase margin is positive .

viii) In case of critical damping, the damping ratio is

a) less than 0 b) 1

c) less than 1 d) grater than 1.

ix) A unity feedback system having an open loop gain becomes stable when

a) mod (k) > 1

b) k > 1

c) mod (k) < 1

d) $k < -1$.

x) The first derivative control can be used to

a) Decrease settling time

b) Decrease damping

c) Decrease velocity error

d) Eigenvalue analysis.

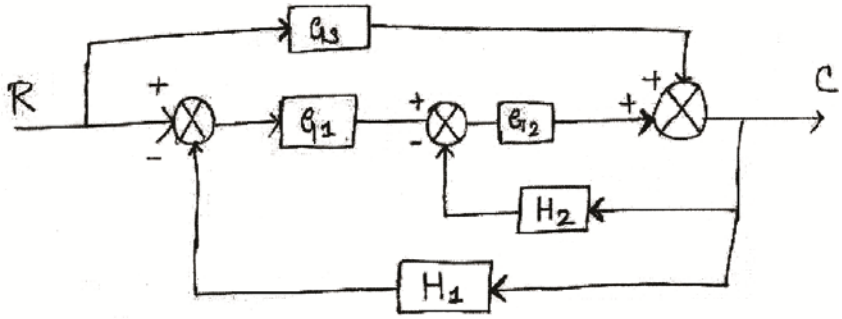
GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Explain the closed loop *vs* open loop control system with example.

3. Use Block Diagram Reduction technique to find out the overall transfer function of the following system.

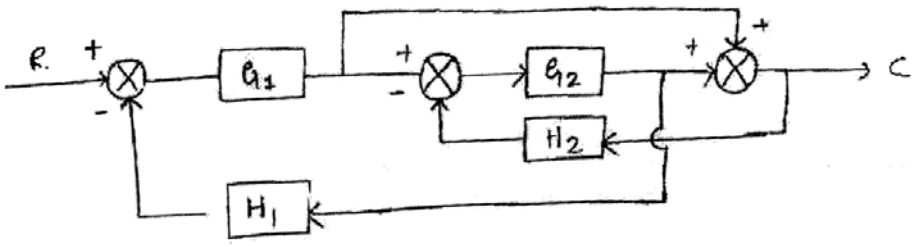


4. A unity feedback system has an open loop transfer function $G(s) = 16/s(s + 8)$. Determine its damping ratio, peak overshoot and time required to reach peak.

5. a) Define error coefficients corresponding to step and ramp inputs.

   b) A unity feedback closed loop second order system has a transfer function $\frac{100}{s^2 + s + 100}$ and it is excited by a step input of 10 units. Find out its steady state error.

6. Find the overall transfer function of the system given below using signal flow graph technique. Draw the SFG of the system also.



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Define state and state space.

   b) The state model of a system is given by

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \quad C = [\,1 \;\; 0 \;\; 0\,]$$

   Determine the characteristic equation and poles of the system.

   c) For the given transfer function obtain the state model.

$$G(s) = \frac{y(s)}{x(s)} = K/(s^3 + a_3 s^2 + a_2 s^1 + a_1)$$

8. a) Stat the Nyquist stability criterion.

   b) What is *Z*-Transform ?

   c) State Routh Stability Criteria.

   d) Using Routh-Hurtwitz criteria determine the stability of the closed loop transfer whose characteristic equation is given as $s^5 + 2s^4 + 2s^3 + 4s^2 + s + 2$. Find also the No. of roots lying in $j\omega$-axis, left half and right half of the *s*-plane.

9. Construct the Bode Plot for unity feedback system whose open loop transfer function is given by

$G(s) = 10(s+20)/(s+1)(s+2)(s+10)$

From the Bode plot determine

a) gain and phase cross-over frequency

b) gain and phase margin

c) stability of the closed loop system

10. A unity feedback control system has an open loop transfer function $G(s) = 1/s(s+2)(s^2+2s+10)$

Sketch the root locus of the system by determining the following :

a) Centroid, number and angle of asymptotes

b) Angle of departure of root loci from the poles

c) Break-away point

d) The value of K and the point of intersection of root locus with JW axis.

11. Write short notes on any *three* of the following :

a) Routh Array

b) Absolute and relative stability

c) Effect of poles and zeros on stability

d) Mason Gain Formula

e) Tachometer.