Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech/(ICE-NEW)/SEM-4/IC-401/2013

2013

BASIC CONTROL THEORY

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 alternatives for the following : 10 × 1 = 10

   i) The transfer function of a system is its

   a) Square response b) Step response

   c) Ramp response d) Impulse response.

   ii) In a signal flow graph

   a) nodes represent variables

   b) branches represent variable

   c) both of these

   d) none of these.

   iii) If the maximum overshoot is 100% the damping ratio is

   a) 0 b) 1

   c) 2 d) 0·5.

iv) The initial slope of the Bode plot for a transfer function having a simple zero at the origin is

a) – 20 dBb/decade b) 20 dBb/decade

c) – 10 dBb/decade d) 10 dBb/decade.

v) The open loop transfer function is generally

a) stable b) unstable

c) marginally stable d) conditionally stable.

vi) In $G(s) = k / s^2 (s + 3)(s + 6)$, the type & order of the system is

a) 3 & 3 b) 2 & 4

c) 3 & 1 d) 3 & 0.

vii) The concept of analogous system is applicable to a

a) linear system only b) non-linear system only

c) both of these d) none of these.

viii) The root loci method of analysis of a control system gives us

a) transient response b) frequency response

c) study state response d) both (a) & (c).

ix) The system represented by its transfer function has some poles lying on the imaginary Axis of the *S*-plane. The system is

a) absolute stable b) conditionally stable

c) unstable d) marginally stable.

x) By increasing the gain, *k*, of the system, the steady-state error of the system

a) increases b) decreases

c) remain unchanged d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. The open-loop transfer function of a unity negative feedback system is given below :

   $G(s) = 500 / S(S + 15)$. Determine —

   a) the transient response for a unit step input

   b) the value of rise time and peak time.

3. Determine the stability of system whose characteristic equation is given by

   $S^5 + 2S^4 + 3S^3 + 6S^2$

4. Draw the polar plot of transfer function $G(s) = 5/s(s + 15)(s - 7)$.

5. Find the transfer function of armature-controlled *d.c.* motor.

6. For the system having $G(s) = 25/S(S + 10)$ and unity feedback, find the following parameters when excited a unit step input.

   a) Wn

   b) Wd

   c) Tp

   d) Mp

   e) ζ

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) State the Nyquist stability criteria.

   b) Using Nyquist stability criteria, determine whether the unity feedback close-loop system having open-loop transfer function $G(S)H(S) = 10 / S(1 + S)(1 + 0{\cdot}05S)$ is stable or not.

   c) What is relative stability ? 3 + 10 + 2

8. a) Sketch the root locus for the system having

   $G(S)H(S) = K(S + 1) / (S + 3)(S + 4)(S + 7)$.

   b) What is root contour ? What is the difference between root locus and root contour ? 10 + 2 + 3

9. a) Explain the meaning and significance of phase margin and gain margin of a control system. How will you obtain the values of these margins from Bode plot.

   b) Sketch the Bode plot for the following function and find out the approximate values of the gain margin & phase margin.

   $G(s) = 10(S + 2) / S(S + 6)(S + 10)$. 7 + 8

10. Write short notes on any *three* of the following : 3 × 5

    a) Servo motor

    b) PID controller

    c) Absolute stability & Relative stability

    d) Tachometers

    e) Effect of poles and zeros on stability.