Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CSE, EE(O), EEE)/SEM-5/EE-503/2010-11

2010-11
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 alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) The characteristic equation of a system is $s^2 + 2s + 2 = 0$. The system is

      a) critically damped b) underdamped

      c) overdamped d) unstable.

   ii) Addition of a pole to the closed loop transfer function

      a) increases size time

      b) decreases size time

      c) increases overshoot

      d) has no effect.

iii) A system has a single pole at origin. Its impulse response will be

a) constant b) ramp

c) decaying exponentially d) oscillatory.

iv) Signal flow graph is

a) topological representation of a set of differential equations

b) gain versus frequency

c) phase versus frequency

d) transient response.

v) The disadvantage(s) of polar plot is (are)

a) the calculations are time consuming for exact plot

b) it is very difficult to calculate gain & phase margins

c) plot is damped at high frequencies

d) all of these.

vi) The function $\frac{1}{1+ST}$ has a slope of

a) – 6 dB/decade b) 6 dB/decade

c) 20 dB/decade d) – 20 dB/decade.

vii) The transfer function of a basic PD controller is given by (all k's are real constant)

a) $k_0 + \frac{k_1}{s} + k_2 s$ b) $k_2 s + k_3 s$

c) $k_0 + k_2 s$ d) $k_0 + \frac{k_1}{s}$.

viii) If the system gain k is increased then the roots of the system moves to

a) low frequency b) higher frequency

c) origin d) none of these.

ix) In mechanical systems, the spring force is proportional to

a) motion b) displacement

c) acceleration d) mass.

x) Phase margin of a system is used to specify

a) time response b) frequency response

c) absolute stability d) relative stability.

xi) If a system is critically damped & the gain is increased, the system

a) becomes overdamped

b) becomes underdamped

c) becomes oscillatory

d) remains critically damped.

xii) The type of a transfer function denotes the number of

a) zeros at origin

b) poles at infinity

c) poles at origin

d) zeros at infinity.

GROUP – B

(Short Answer Type Questions)

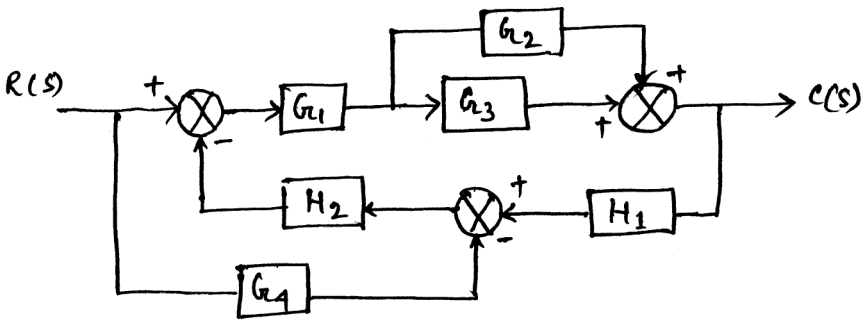
Answer any *three* of the following. 3 × 5 = 15

2. The closed loop response of a system subjected to a unit step input is $c(t)=1+0\cdot2e^{-60t}-1\cdot2e^{-10t}$. Obtain the expression for the closed loop transfer function. Also determine the undamped natural frequency and damping ratio of the system.

3. Using Routh-Hurwitz criterion, determine the stability of the closed loop system that have the following characteristic equation.

$s^6+2s^5+8s^4+15s^2+20s^2+16s+16=0$.

4. Using block diagram reduction technique find $\frac{C}{R}$.



5. Obtain the rise time, peak time, maximum peak overshoot & settling time of the unit step response of a closed loop system given by $\frac{c(s)}{k(s)} = \frac{16}{s^2 + 2s + 16}$.

6. For a closed loop system with $G(s) = \frac{1}{s+5}$ & $H(s) = 5$, calculate the generalised error coefficient & fluid error series.

GROUP – C

(Long Answer Type Questions)

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

7. Draw the Bode plot for a unity feedback system with $G(s) = \frac{k(s+0\cdot3)}{(s+4)(s^2+30s+20)}$ where k = 2000. Determine the gain margin & phase margin. Comment on stability. Determine the value of k to obtain phase margin of 30°.

8. Plot the root locus for a unity feedback closed loop system whose open loop transfer function is

$$G(s)=\frac{1}{s(s+4)\left(s^2+2s+2\right)}$$

Show all the relevant steps of plot.

9. a) What is the difference between type & order of a system ?

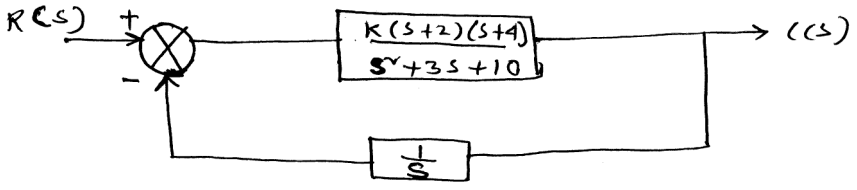
b) Sketch a typical step response of a second order under - damped system.

c) Draw the response characteristic curves of the following controlling actions :

P, *I*, *D*, *PI*, *PD* & *PID*.

Discuss salient features. 3 + 3 + 9

10. For the system shown below, find the phase margin & gain margin using Nyquist plot for k = 10. Find also range of k for stability.



11. a) Explain with the help of an example how improvement of system performance is achieved through compensation.

b) Write a note on servo motors. 10 + 5