



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) $k_0 + \frac{k_1}{s} + k_2s$
- b) $k_2s + k_3s$
- c) $k_0 + k_2s$
- 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)

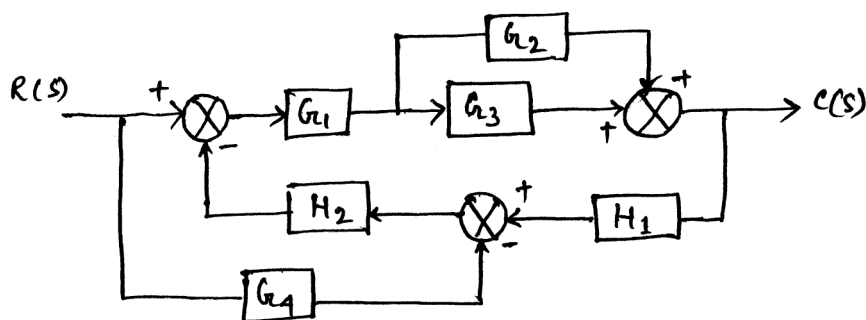
Answer any *three* of the following.

3 × 5 = 15

2. The closed loop response of a system subjected to a unit step input is $c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$. 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)

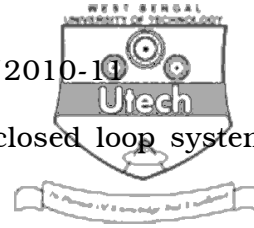
Answer any *three* of the following. $3 \times 15 = 45$

7. Draw the Bode plot for a unity feedback system with

$$G(s) = \frac{k(s+0.3)}{(s+4)(s^2+30s+20)} \text{ where } k = 2000. \text{ Determine the}$$

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

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

Show all the relevant steps of plot.

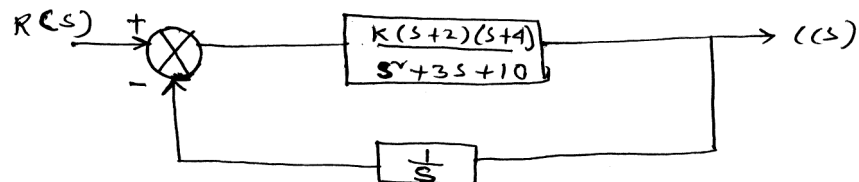
9. a) What is the difference between type & order of a system ?
- b) Sketch a typical step response of a second order under - damped system.
- c) Draw the response characteristic curves of the following controlling actions :

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

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