Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(ICE-NEW)/SEM-4/IC-401/2012

2012

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 any *ten* of the following :

$10 \times 1 = 10$

i) The transfer function of a system is

a) a square wave response

b) step response

c) ramp response

d) impulse response.

ii) Mason's gain formula is used to find

a) OLTF b) CLTF

c) feed forward TF d) feedback TF.

iii) The initial slope of the Bode plot for a TF having a simple zero at origin is

a) – 20 dB/decade b) 10 dB/decade

c) + 20 dB/decade d) – 10 dB/decade.

iv) Value of ξ for some system is unity. The system response will be

a) overdamped b) critically damped

c) underdamped d) oscillatory.

v) Damped ratio (ξ) of a process with transfer function $\frac{8}{5s^2+3s+5}$ is

a) $\frac{4}{5}$ b) $\frac{3}{2}$

c) $\frac{\sqrt{21}}{5}$ d) $\frac{\sqrt{91}}{5}$.

vi) Step response of a system with the TF $G(s)=\frac{1}{\tau s+1}$ attains more than 98% of its final value in time t =

a) 2τ b) 3τ

c) 4τ d) 1τ.

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

a) transient response b) s.s. response

c) frequency response d) both (a) and (b).

viii) Integral error control

a) increases the order

b) decrease the order

c) increases the s.s. error

d) does not affect the s.s. error.

ix) Addition of pole to the CLTF

a) increases rise time b) decreases rise time

c) increases overshoot d) has no effect.

x) By the use of PD control to a second order system the rise time

a) decreases b) increases

c) remains same d) has no effect.

xi) Single pole at the origin represents

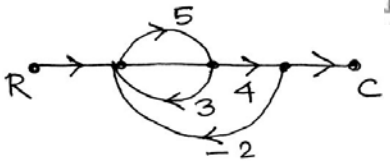
a) a unit step response

b) an oscillatory response

c) an unstable system

d) an exponentially decay response.

xii) In the following signal flow graph, value of C/R is



a) 28/57 b) 40/81

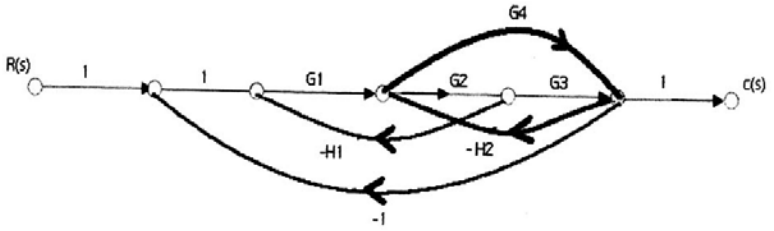
c) 40/57 d) 28/81.

GROUP – B

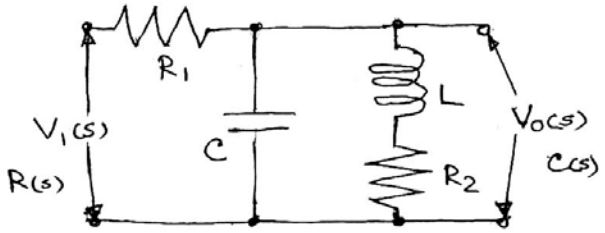
(Short Answer Type Questions)

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

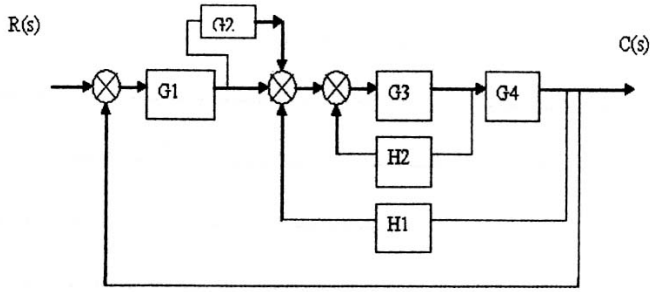
2. Find the transfer function from the following signal flow graph using Mason's gain formula.



3. Derive the transfer function of the network shown below :



4. Using 'block diagram reduction' technique, find the closed loop transfer function of the system whose block diagram is given below :



5. Using Routh-Herwitz criterion, determine the stability of the system having characteristic equation :

$$s^4 + 2s^3 + 10s^2 + 20s + 5 = 0$$

6. For a unity feedback system the open loop transfer function (OLTF) of a heating system is given by :

$$G(s) = \frac{10000}{(1+s)(1+0\cdot 5s)(1+0\cdot 02s)}$$

The output set point is 500°C. What is the steady state temperature ?

GROUP – C

(Long Answer Type Questions)

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

7. For a unity feedback system OLTF is given by

$$G(s) = \frac{K}{s(s+2)(s^2+6s+25)}$$

a) Sketch the root locus for $0 \le K \le \infty$.

b) At what value of *'K'* the system becomes unstable ?

c) At this point of instability determine the frequency of oscillation of the system. 1

8. Draw the Bode plot of the TF, $G(s)=\frac{25}{s(s+1)(s+10)}$. Also find Phase Margin and Gain Margin.

9. a) Derive the time domain response of a First Order System using unit Ramp function.

b) Consider the unit step response of a unity feedback control system whose OLTF is $G(s)=\frac{1}{s(s+1)}$. Obtain the maximum overshoot, peak time, settling time, rise time.

c) For a unity feedback control system the forward path transfer function is given by

$$G(s)=\frac{20}{s(s+2)(s^2+2s+20)}.$$

Determine the steady state error of the system when the inputs are (i) 5, (ii) $5t$, (iii) $\frac{3t^2}{2}$.

10. The OLTF of a unity feedback system is given by $G(s)\,H(s)=\frac{5}{s(s+1)(s+2)}$. Draw the Nyquist plot and hence find out whether the system is stable or not.

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

a) PID controller

b) Lead Lag compensation

c) Armature controlled DC servomotor

d) Gain Margin and Phase Margin

e) Static error coefficients.

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