ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

CONTROL SYSTEMS

SEMESTER – 4

Time : 3 Hours] [Full Marks : 70

Graph paper and semi-log paper are provided at the end of this booklet.

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 its

a) square wave response b) step response

c) ramp response d) impulse response. ☐

ii) The concept of analogous system is applicable to

a) linear systems only

b) non-linear systems only

c) both linear & non-linear systems

d) non-linear systems but can be extended to linear systems too. ☐

iii) In a signal flow graph

a) nodes represent variables

b) branches represent variables

c) some specified nodes & some specified branches represent variables

d) only one node & all branches represent variables. ☐

iv) PID controller improves the

a) steady state response only

b) transient response only

c) both steady state response & transient response

d) none of these.

v) Nyquist criterion for determination of stability of control systems is

a) algebraic method b) graphical method

c) semi-graphical method d) none of these.

vi) A control system is defined by the relationship $\frac{d^2x}{dt^2}+6\frac{dx}{dt}+5x = 12\left(1-e^{-2t}\right)$. The response of the system at $t \to \infty$ is

a) $x = 6$ b) $x = 2$

c) $x = 2{\cdot}4$ d) $x = -2$.

vii) The number of root loci for a unity feedback system having open loop transfer function with finite n number of poles & finite m number of roots is

a) $m - n$ b) $n - m$

c) m d) n.

viii) The transfer function of a basic PI controller is given by (all k's are real constants)

a) $k_0+\frac{k_1}{s}+k_2s$ b) k_0+k_2s

c) k_1s+k_2s d) $k_0+\frac{k_1}{s}$.

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

a) – 20 dB/decade b) 10 dB/decade

c) 20 dB/decade d) – 10 dB/decade.

x) If the maximum overshoot is 100%, the damping ratio is

a) 1 b) 0

c) 0·5 d) ∞. ☐

xi) The input-output equation of a system is given by $Y = mx + c$, where m & c are constants. The system is

a) linear b) non-linear

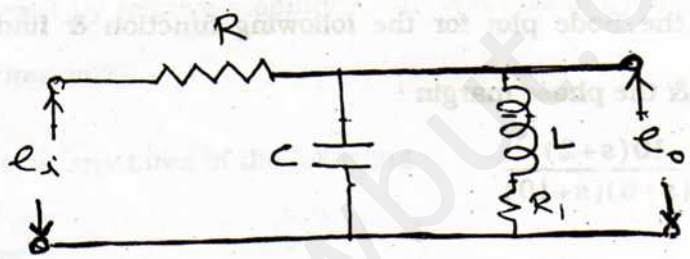
c) active d) passive. ☐

GROUP – B

(Short Answer Type Questions)

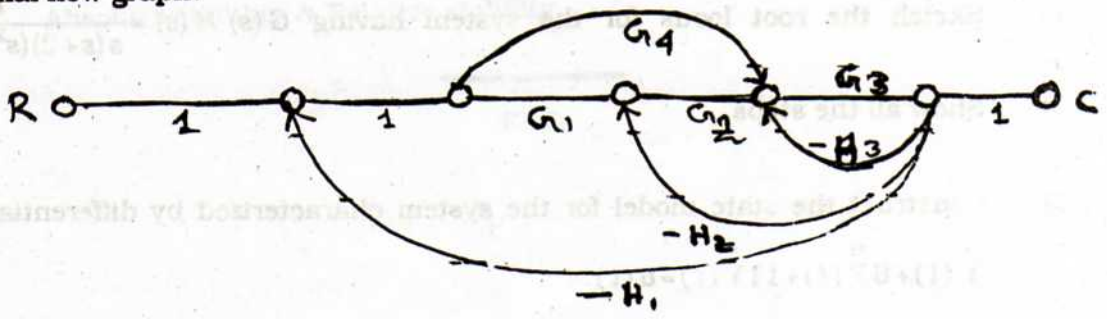
Answer any *three* of the following questions. 3 × 5 = 15

2. Derive the transfer function of the network shown below



3. Find the stability of the system whose characteristic equation is given by $s^5 + 2s^4 + 3s^3 + 6s^2 + 5s + 3 = 0$.

4. Find out the overall transfer function C/R of the following system using the rules of signal flow graph.



5. a) Define error efficients corresponding to step & ramp inputs.

b) A unity feedback closed loop second order system has a transfer function $\frac{81}{s^2+0{\cdot}6s+9}$ & it is excited by a step input of 10 units. Find out its steady state error. 2 + 3

6. A unity feedback system has an open loop transfer function $G(s)=\frac{25}{s(s+8)}$. Determine its damping ratio, peak overshoot & time required to reach peak.

GROUP – C

(Long Answer Type Questions)

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

7. a) Explain the meaning and significance of phase margin & gain margin of a control system. How will you obtain the values of these margins from Bode plots ?

b) Sketch the Bode plot for the following function & find out the value of gain margin & the phase margin :

$G(s)=\frac{10(s+2)}{s(s+6)(s+10)}$. 6 + 7 + 1 + 1

8. a) A unity feedback control system has open loop transfer function $G(s)=\frac{k}{s^3+s^2+s-3}$.

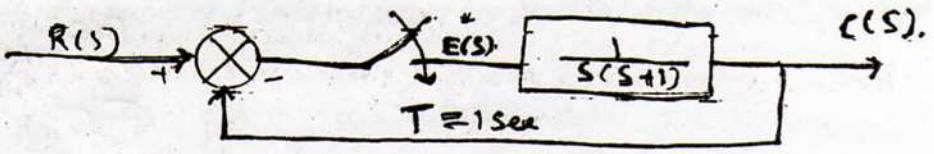
Find out the range of values of k so that the closed loop system is stable.

b) Sketch the root locus for the system having $G(s)\,H(s)=\frac{k}{s(s+2)(s^2+4s+20)}$.

Show all the steps. 5 + 10

9. a) Construct the state model for the system characterized by differential equation $\dddot{Y}(t)+6\ddot{Y}(t)+11\dot{Y}(t)=u(t)$.

b) Find the pulse transfer function for the sampled system shown in the following figure.



7 + 8

10. a) State the Nyquist stability criterion.

b) Using Nyquist stability criterion, determine whether the unit feedback close loop system having open loop transfer function $G(s)\,H(s) = \frac{10}{s(1+s)(1+0\cdot05s)}$ is stable or not.

c) What is meant by relative stability ? Can you find out relative stability by Routh stability criterion ? 3 + 7 + 5

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

a) Servo motor

b) PID controller

c) Sample & Hold circuits

d) Absolute stability & Relative stability.

END