Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (ECE)/SEM-5/EC-513/2010-11

2010-11

CONTROL SYSTEMS

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 insertion of negative feedback in a control system affects

a) the transient response to vanish uniformly

b) the transient response to decay very fast

c) no change in transient response

d) the transient response decays at a slow state.

ii) The location of the closed loop conjugate pair of poles on the Jw axis indicates that the system is

a) stable b) unstable

c) marginally stable d) critrically stable.

iii) The gain of a system is 10. In terms of dB it is

a) 0 dB b) 1 dB

c) 20 dB d) 100 dB.

iv) The phase margin of a system is used to specify

a) time response b) frequency response

c) absolute stability d) relative stability.

v) If the gain of an open loop system is doubled, the gain margin

a) is not affected b) gets doubled

c) becomes half d) becomes 1/4th.

vi) Addition of poles to the closed loop transfer function

a) increases rise time b) decreases rise time

c) increases overshoot d) has no effect.

vii) A system has a pole at origin, its impulse response will be

a) constant b) ramp

c) decaying exponentially d) oscillatory.

viii) In force-voltage analogous system, displacement is equivalent to

a) current b) flux

c) charge d) inductance.

ix) Root locus technique is applicable to

a) single loop system

b) multiple loop system

c) single as well as multiple loop system

d) not more than two loop systems.

x) The Z transform $F(Z)$ of function $f(nt) = a^{nt}$ is

a) $\frac{Z}{z-a^{T}}$ b) $\frac{Z}{z+a^{T}}$

c) $\frac{Z}{z+a^{-T}}$ d) $\frac{Z}{z-a^{-T}}$.

xi) The membership value of Fuzzy control sytem is varied within the range

a) 0 to 1

b) 1 to 2

c) 0 to – 1.

xii) The transfer function for the state variable representation $\frac{dx}{dt} = Ax + Bu, Y = Cx + Du$ is given by

a) $D+C(SI-A)^{-1}B$ b) $B(SI-A)^{-1}C+D$

c) $B(SI-A)^{-1}B+C$ d) $C(SI-A)^{-1}D+B$.

GROUP – B

(Short Answer Type Questions)

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

2. A system is represented by the state & output equations is given below. Find :

   a) Characteristic equation

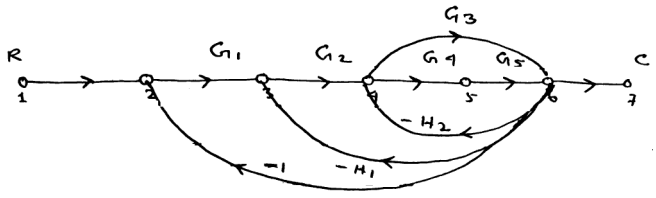
   b) The poles.

$$\dot{X} = \begin{bmatrix} 0 & 1 & 2 \\ 0 & 3 & 4 \\ 1 & 3 & 2 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

$$Y = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix} X .$$

3. For a unity feedback system having open loop transfer function as $G(s) = \dfrac{k(s+2)}{s^2\left(s^2+7s+12\right)}$, determine (a) number of types of the system, (b) error constants and (c) steady state error for parabolic input.

4. Find $\dfrac{C}{R}$ of the following signal flow graph using Mason's gain formula.



5. For a system with $F(s) = s^4 + 22s^3 + 10s^2 + s + k = 0$, obtain the marginal value of k & the frequency of oscillation for that value of k.

6. A system is described by $\dot{X} = \begin{bmatrix} 1 & -1 \\ 1 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$

$Y = \begin{bmatrix} 1 & 0 \end{bmatrix} X$.

Check the controllability & observability of the system.

GROUP – C

(Long Answer Type Questions)

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

7. The open loop transfer function of an unity feedback system is given by $G(s) = \dfrac{k}{s(1+0\cdot02s)(1+0\cdot04s)}$. draw the Bode plot. Find the gain margin & phase margin. Hence find the values of open loop gain so that the system has a phase margin of 45°.

8. The loop transfer function of a feedback control system is given by $G(s)H(s) = \dfrac{k(s+6)}{s(s+4)}$.

   a) Sketch the root locus plot with K as a variable parameter & show that loci of complex roots are part of a circle.

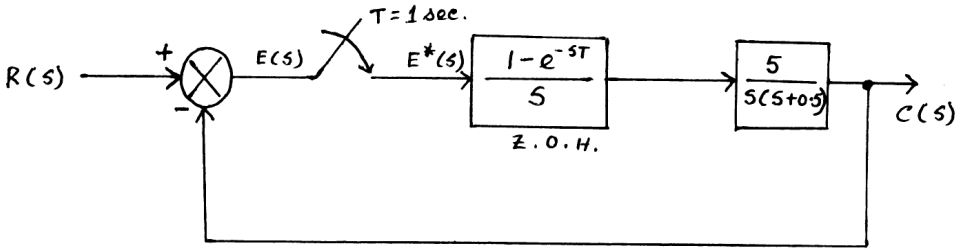
   b) Determine the break away/break in points if any.

   c) Determine the range of K for which the system is under-damped.

9. a) Find the z-transform of $\sin \omega t$.

b) A sampled data system has a transfer function : $G(s) = 1/(s + 1)$. If the sampling time is one second and the system is subjected to unit-step input function, determine the discrete time response.

c) Obtain z-transform for the following block diagram shown in the figure.



10. a) Write down the advantages and disadvantages of state space techniques.

b) Realize H(s) in cascade form :

$$H(s) = \frac{s(s+2)}{(s+1)(s+3)(s+4)}.$$

c) Obtain the eigenvalues and eigenvectors for a system described by

$$\dot{X} = \begin{bmatrix} 0 & 6 & -5 \\ 1 & 0 & 2 \\ 3 & 2 & 4 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} U \text{ and } Y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} X. \qquad 3 + 6 + 6$$

11. a) Write a note on PID controller.

b) With the help of an example, explain the principle of fuzzy logic in control engineering. 5 + 10