

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 × 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 $J\omega$ axis indicates that the system is
- a) stable
 - b) unstable
 - c) marginally stable
 - d) critically stable.

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

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GROUP - B**(Short Answer Type Questions)**Answer any *three* of the following. $3 \times 5 = 15$

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

a) Characteristic equation

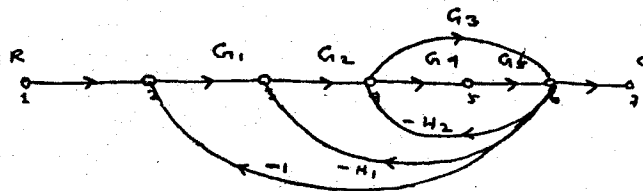
b) The poles.

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

$$Y = [1 \ 1 \ 0] X.$$

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

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



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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. $3 \times 15 = 45$

7. The open loop transfer function of an unity feedback system is given by $G(s) = \frac{k}{s(1+0.02s)(1+0.04s)}$. 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° .

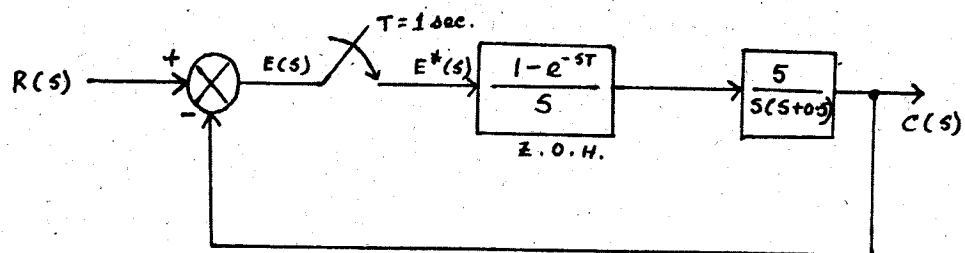
8. The loop transfer function of a feedback control system is given by $G(s)H(s) = \frac{k(s+6)}{s(s+4)}$.

- Sketch the root locus plot with K as a variable parameter & show that loci of complex roots are part of a circle.
- Determine the break away/break in points if any.
- Determine the range of K for which the system is under-damped.

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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 :

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

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

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

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
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