Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech 2nd year

Branch : ECE | Semester: 4th

Title of the Course : Control Theory | Course Code: ECL-251

Time: 3 Hours | Maximum Marks: 50

Section-1

Note: Attempt all questions

Q.1 If A= $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then find the state transition matrix e^{At}. [2]

Q.2 The state diagram of a system is shown below is described by the state variable equations: [2]

$$X= AX +Bu,\ y= CX + Du$$

find the state variable equations of the given system.

Q.3 Find the valid breakaway point of the given system. [2]

$$G(s)H(s)= \frac{K}{S(S+2)(S+3)}$$

Q.4 Draw the polar plot of the given system. [2]

(a) GH(s) = K/S (b) $GH(s) = K/S^3$

Q.5 A second order system transfer function given by $G(s)= \frac{25}{s^2+8s+25}$ if the system is initially at rest is subjected to a unit step input at t=0. Find the time at which second peak occurs in the response. [2]

Section-2

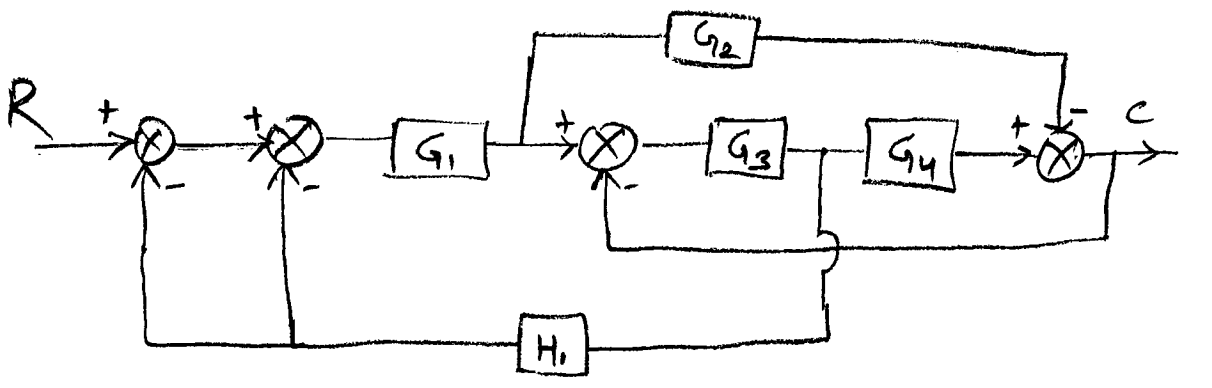
Note: Attempt any four questions

Q.6 Using Nyquist criterion investigation the closed loop stability of the system whose open loop transfer function is given by

$$G(s)H(s) = \frac{K(s+1)}{(s+0.5)(s-2)}$$

Consider (i) K=1.25, (ii) K=0.25 [5]

Q. 7 Determine C/R for the block diagram given below. (using signal flow graph) [5]



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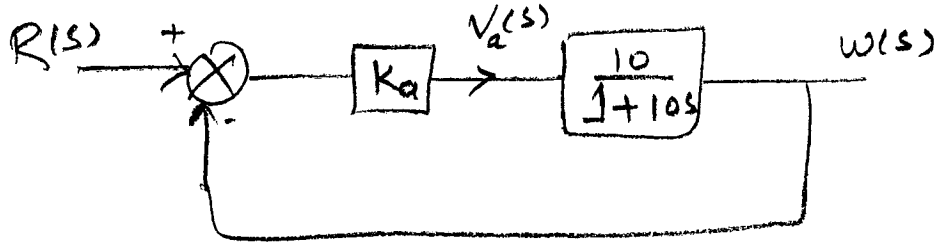
Q.8 The open loop transfer function of a dc motor is given as $\frac{\omega(s)}{V_a(a)} = \frac{10}{1+10s}$ when connected in feedback as shown in figure below. Find the approximate value of K_a that will reduce the time constant of the closed loop system by one hundred times as compared to that of the open loop system. [5]



Q.9 Determine the transfer function matrix from the given data. [5]

$$A=\begin{bmatrix}-3 & 1\\ 0 & -1\end{bmatrix},\ B=\begin{bmatrix}1\\1\end{bmatrix},\ C=[1\ 1] \text{ and } D=0.$$

Q.10 The open loop transfer function of a unity feedback control system is given by [5]

$$G(s) = \frac{K}{s(sT_1+1)(sT_2+1)}$$

Apply Routh-Hurwitz criterion determine the value of K in term of T_1 and T_2 for the system to be stable.

Section-3

Note: Attempt any two questions

Q.11 Draw the root locus of the given system and find the values of K for which the system is over damped, critically damped and under damped.

$$GH(s) = \frac{K(S+2)}{S(S+1)}$$ [10]

Q.12 The transfer function of a control system is given by [10]

$$\frac{Y(s)}{U(s)} = \frac{s+2}{s^3+9s^2+26s+24}$$

Check for controllability and observability.

Q.13 A unity feedback system is given by [10]

$$G(s) = \frac{K(1-s)}{s(s+3)}$$

Draw the root locus of the system.