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 Routh Hurwitz criterion gives [1]

(a) Number of roots in the right half of the s-plane (b) Value of the roots

(c) Number of roots in the left half of the s-plane (d) Number of roots in the top half of the s-plane

Q.2 The breakaway point calculated mathematically must always lie on the root locus. [1]

(a) True (b) False

Q.3 Roots on the imaginary axis makes the system [1]

(a) Stable (b) Unstable (c) Marginally stable (d) Linear

Q.4 The damping ratio and peak overshoot are measures of [1]

(a) Relative stability (b) Speed of response (c) Steady state error (d) Absolute stability

Q.5 According to Nyquist stability criterion, where should be the position of all zeros of q(s) corresponding to s-plane? [1]

(a) On left half (b) At the center (c) On right half (d) Random

Q.6 The equation $2s^4+s^3+3s^2+5s+10=0$ has roots in the left half of s–plane [1]

(a) One (b) Two (c) Three (d) Four

Q.7 The concepts used to measure relative stability are [1]

(a) Phase margin (b) Gain margin (c) Phase and Gain margin (d) Stable

Q.8 As the polar plot moves toward the point (-1, 0) then the system becomes [1]

(a) Stable (b) Marginally stable (c) Conditionally stable (d) Unstable

Q.9 The steady error of a stable type 0 unity feedback system for a unit step function is..... [1]

Q.10 Draw the polar plot of the system: GH(s) = K/S [1]

Section-2

Note: Attempt any four questions

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. [5]

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. [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]

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

Section-3

Note: Attempt any two questions

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

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

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

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. [10]

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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.

by B.S. Manke