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R2008

B.E./B.Tech DEGREE EXAMINATION APRIL/MAY 2012

Electrical and Electronics Engineering

III Semester

EE9201 Control Systems

(Semi log sheets, Graphs, Nichols Chart and Polar Graph will be supplied)

Time: 3 Hrs **Answer All Questions** **Max.Marks:100**

PART - A (10 X 2 = 20)

1. Define :Transfer function.
2. Write Masons Gain formula.
3. Define Rise time.
4. Identify the type of natural response associated with the following characteristic polynomial:

   s^2+s+25

5. Define: Gain margin
6. List out the different frequency domain specifications?
7. What are root loci?
8. State Nyquist stability criterion.
9. State the advantages of state space analysis.
10. Define: Controllability

PART - B (5 X 16 = 80)

11.i. Calculate state transition matrices for system with the following state coupling matrices A, using [4]

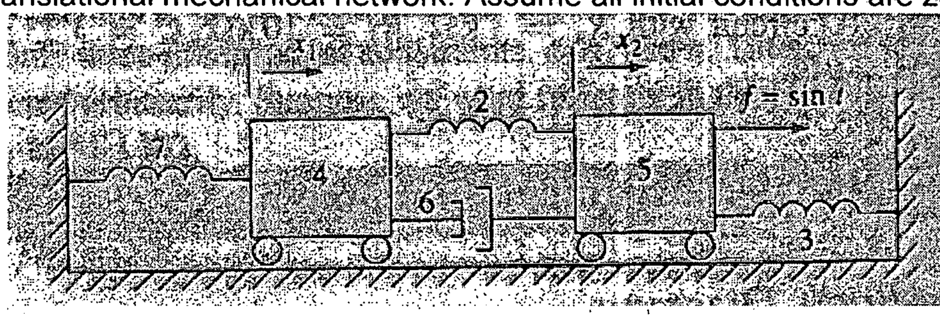
$$\begin{matrix} -16 & 0 \\ -9 & 5 \end{matrix}$$

ii. Find the characteristics equations of the following system, then analyse the stability. [12]

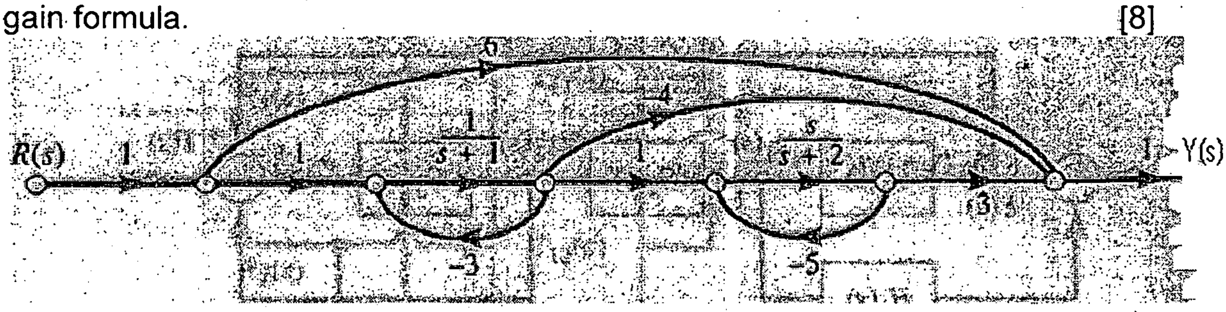
$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -1 & -2 & 2 \\ 2 & 0 & 6 \\ -1 & 2 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 2 & -1 \\ 0 & 0 \\ 2 & 8 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$y = \begin{bmatrix} 4 & 0 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

12.a.i. Write simultaneous Laplace transformed differential equations for the following translational mechanical network. Assume all initial conditions are zero. [8]

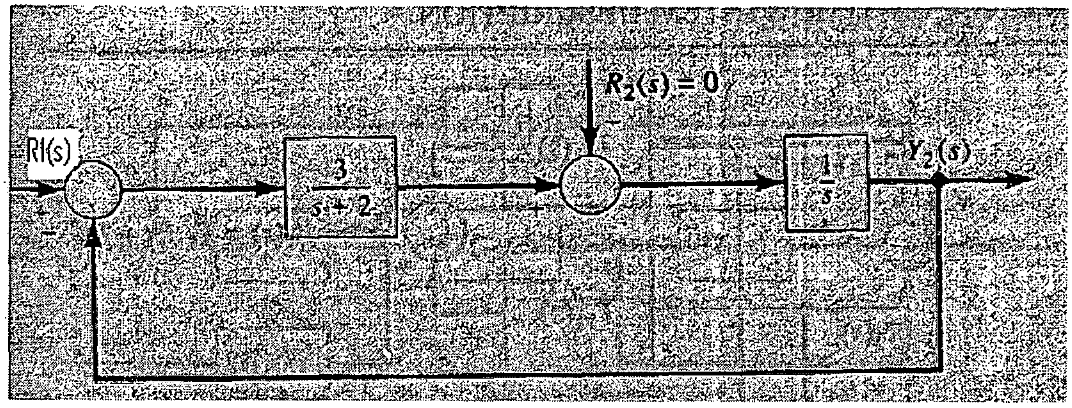


ii. Find the transfer function for the following signal flow graph using Mason's gain formula. [8]



(OR)

b.i. Reduce the following block diagram and obtain the transfer function. [10]



ii. Discuss about the DC servo motor and specify the transfer function. [6]

13.a.i. By using Routh Hurwitz criterion analyse the stability of the following polynomial [8]

$$p(s)= s^6+8s^5+10s^4+20s^3+78s^2+4s+45$$

ii. For a second order system with the following transfer function, determine the undamped natural frequency, the damping ratio and the oscillation frequency[8]

$$T(s) = \frac{s^2 + 25s}{s^2 + 8s + 45}$$

(OR)

b.ii. Sketch the root locus for the following transfer function [16]

$$G(s)H(s)= \frac{1}{(s^2-1)(s^2 + 4)}$$

14.a.i. Sketch the Nyquist plot for feedback systems with the following loop transmittance, then comments on stability. [10]

$$G(s)\,H(s) = \frac{s^2}{S^2+5s+11}$$

ii. Consider the unity feedback system with transfer function then obtain the Equation of a circle in the X-Y plane [6]

$$T(s) = \frac{G}{1+G}$$

(OR)

b. By using Bode plot analyse the stability of the following loop transmittance with phase margin and gain margin. [16]

$$G(s)\,H(s) = \frac{5(s+1)}{s(s+4)(s+7)}$$

15.a. Design Cascade Lead compensator for unity feedback systems with the following transmittances. Find the steady state errors to unit step and ramp inputs, the amount of relative stability, and the damping ratios of any complex closed loops. Choose a for maximum relative stability and leave $K = K_u$ [16]

$$G(s) = \frac{8}{s^2+9s+16}$$

$$K_u = 1$$

(OR)

b.i. State the advantages and disadvantages and compare P, PI and PID controller. [6]

ii. Use Bode design methods to select the PI compensator for [10]

$$G_p(s) = \frac{s+5}{s(s^2+10s+43)}$$

$$K_u = 20$$