Code No: NR220206 **Set No. 1**

II B.Tech II Semester Supplementary Examinations, Nov/Dec 2005
CONTROL SYSTEMS
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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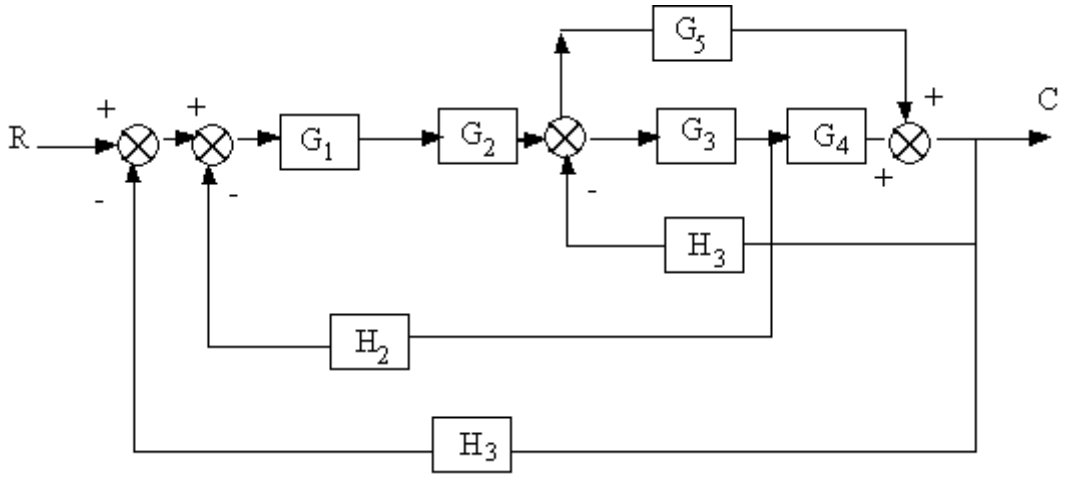

Figure 1:

1. Using block diagram reduction technique find the transfer function for the system shown in Figure 1 below and verify the transfer function by mason's gain formula. [8+8]

2. (a) Derive the Transfer Function for potential divider.
   (b) Derive the Transfer Function for a.c. servomotor. [8+8]

3. (a) A unity feedback system has a forward path transfer function G(s)=$\frac{9}{s(s+1)}$. Find the value of damping ratio, undamped natural frequency of the system, percentage overshoot, peak time and settling time.
   (b) Measurements conducted on servomechanism show the system response to be c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t} when subjected to a unit-step unit. Obtain the expression for the closed-loop transfer function. [10+6]

4. (a) Determine the range of value of k for the system to be stable and is characterized by the equation $s^3 + 3Ks^2$ + (K +2)s+4 = 0.
   (b) A unity feedback system has an open loop transfer function G(s)= $\frac{K}{(s+2)(s^2+4s+8)}$. Use Routh's test to determine the range of positive values of 'K' for which the system is stable. [8+8]

5. Sketch the root locus diagram for a feedback system the characteristic equation of which is given by, G(s)H(s)=$\frac{K}{s(s+2)(s^2+2s+2)}$. Show clearly the steps involved. [12+4]

6. (a) Explain the concept of phase margin and gain margin [8]

   (b) Draw the Bode Plot for the system having G(s)=$\frac{10}{s(1+0.01s)(1+0.1s)}$, H(s) = 1. Determine

   i. The gain cross over frequency and corresponding phase margin.

   ii. The phase cross over frequency and corresponding gain margin.

   [4+4]

7. (a) Explain clearly Nyquist criterion for stability of control systems.

   (b) Determine the stability of the system using Nyquist criterion whose open loop transfer function is G(s)H(s) = $\frac{(s-1)}{s(s+1)}$. [6+10]

8. (a) Obtain the solution of a system whose state model is given by X = A X(t) + B U(t) ; X(0) =X_0 and hence define state Transition matrix.

   (b) Obtain the transfer function of a control system whose state model is [8+8]

$$\dot{X}(t) = A\,X(t) + B\,U(t) \qquad Y(t) = CX(t)$$

Where $A = \begin{pmatrix} 0 & 1 & 0 \\ 0 & -1 & 1 \\ 0 & -1 & -10 \end{pmatrix}$

$B = \begin{pmatrix} 0 \\ 0 \\ 10 \end{pmatrix}$ $C = \begin{pmatrix} 1 & 0 & 0 \end{pmatrix}$

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