

B.Tech II Year - II Semester Examinations, April/May-2012
CONTROL SYSTEMS
 (COMMON TO EEE, ECE, EIE)

Time: 3 hours

Max. Marks: 80

Answer any five questions
 All questions carry equal marks

- - -

- 1.a) Explain the merits and demerits of open loop and closed loop systems. Also explain briefly the classification of control systems.
 b) Derive an equivalent model in terms of the coordinate x , and another in terms of θ , for the system given below (Figure.1). [8+8]

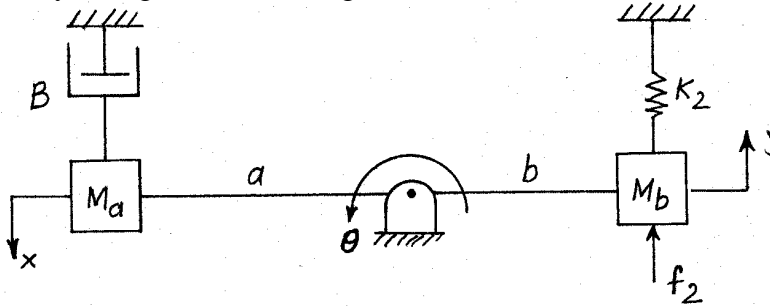


Figure.1

- 2.a) Find the transfer function of the system shown in Figure.2

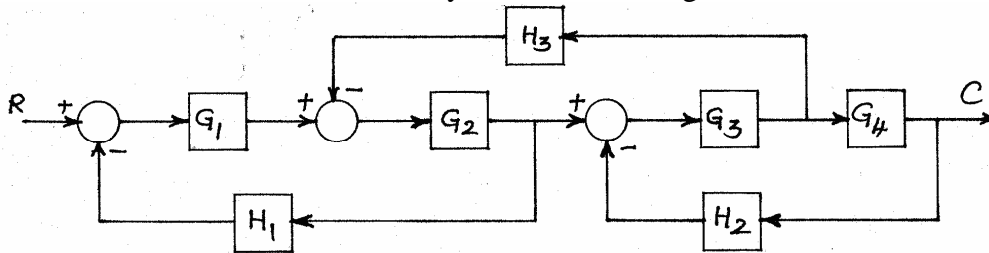


Figure.2

- b) Find the transfer function of a field controlled d.c. servo motor. [8+8]
3. What are the effects of feedback? Explain effect on sensitivity and determine the sensitivity of closed loop transfer function T with respect to G and H , the forward path and feedback path transfer functions respectively for $\omega = 1$ rad/sec for a simple closed loop systems with forward transfer function $G = \frac{10}{s(1+s)}$ and $H = 5$. [16]
- 4.a) 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.
 i) Obtain the expression for the closed-loop transfer function.
 ii) Determine the undamped natural frequency and damping ratio of the system.
 b) Explain any one important time – response specification of a standard second ordered system to a unit step input. [12+4]

5.a) A unity feedback control system is characterized by the open-loop transfer function $G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$. Using the Routh's criterion, determine the range of values of K for the system to be stable.

b) The open-loop transfer function of a servo system with a unity feedback is $G(s) = \frac{400}{s(1+0.1s)}$. Determine the steady-state error for an input $r(t)=1+2t+t^2$.

Also calculate the error constants K_p , K_v and K_a . [6+10]

6. Sketch the root-locus diagram of a control system whose loop transfer function is $G(s)H(s) = \frac{K}{s(s+4)(s+8)}$. Using the diagram or otherwise, find the values of gain at breakaway points and at point of intersection of the loci with the imaginary axis. Also find the gain margin. [16]

7.a) Sketch the Bode plot for the following transfer function and identify the gain crossover frequency for $K=10$.

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$$

b) Sketch the Nyquist plot for the transfer function:

$$G(s)H(s) = \frac{52}{(s+2)(s^2+2s+5)}. \quad [8+8]$$

8.a) What are the properties of state transition matrix? Explain.

b) The state space representation of a system is given by

$$\dot{X} = \begin{bmatrix} -5.0 & 1 \\ -6 & 0.0 \end{bmatrix} X.$$

Find the value of $x_1(t)$ at $t=1$, if $x_1(0)=1.0$ and $x_2(0)=0$. [16]

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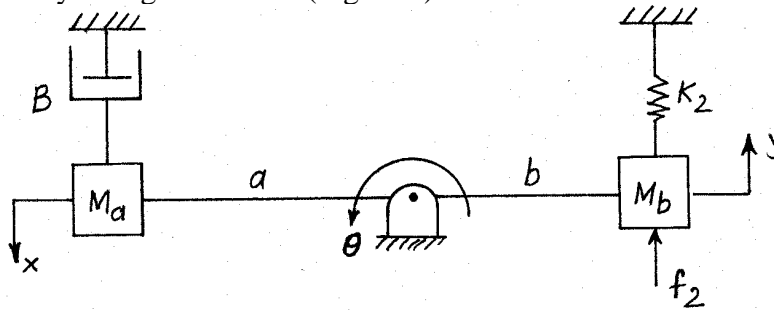


Figure.1

8.a) Find the transfer function of the system shown in Figure.2

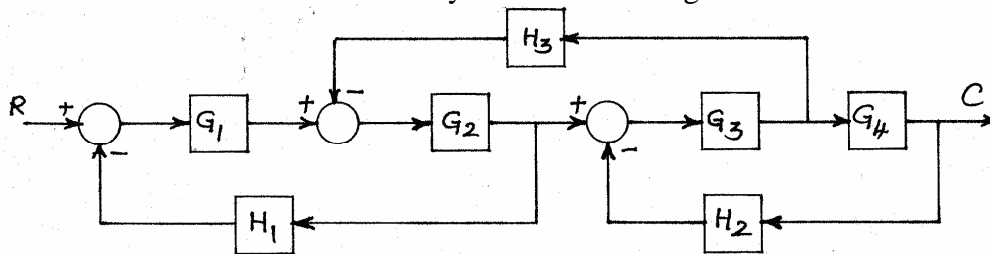


Figure.2

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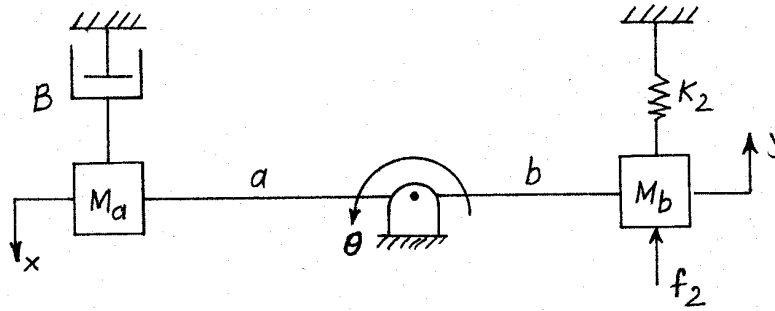


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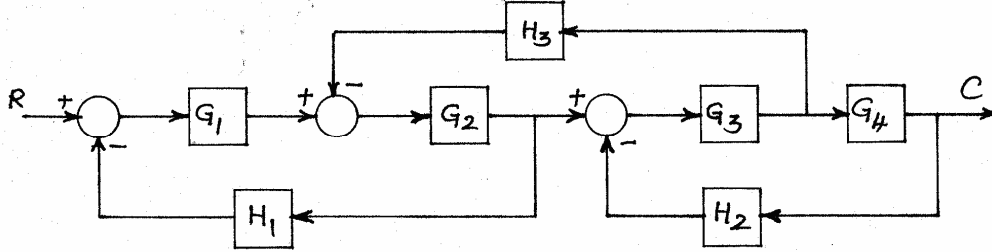


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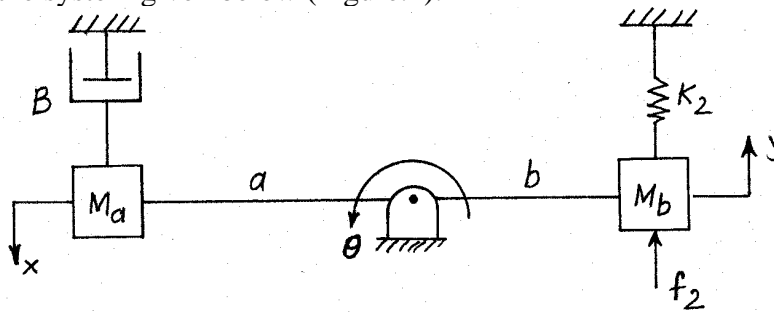


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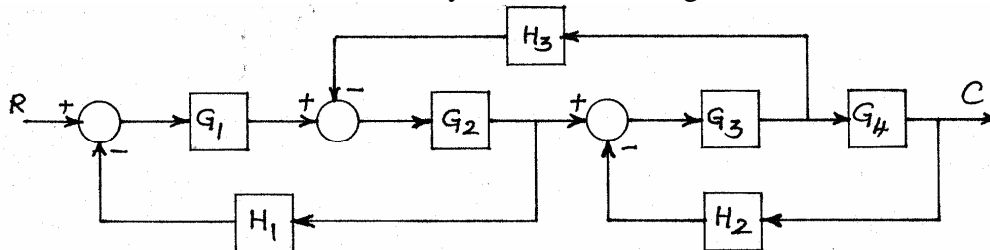


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