B.E. (with Credits)-Regular-Semester 2012 - Mechanical Engineering Sem VI

ME601 - Control System & Engineering

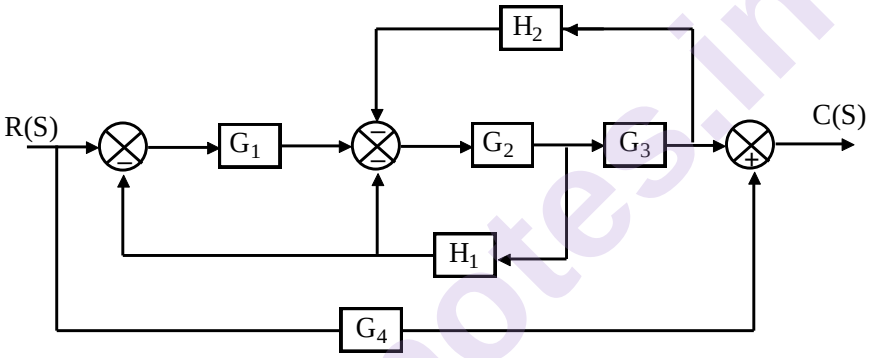
P. Pages : 3 **GUG/W/16/5393**

Time : Three Hours * 3 5 6 1 * Max. Marks : 80

Notes : 1. Solve Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6, Q. 7 or Q. 8, Q. 9 or Q. 10.
2. All questions carry as indicated marks.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Use of polar plot, semilog paper, graph paper is permitted.

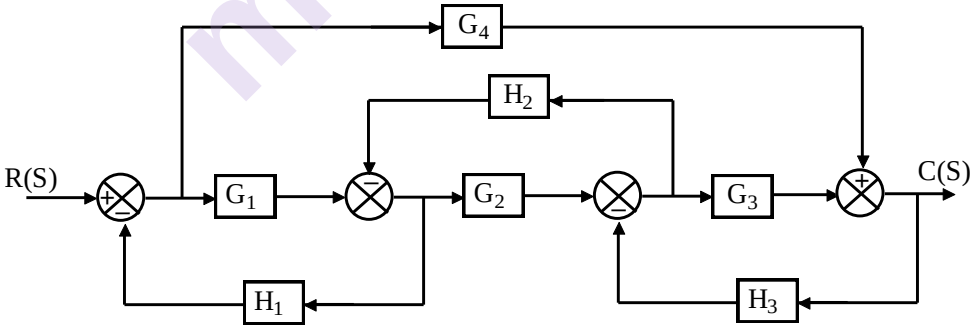
1. a) Define transfer function and derive the transfer function of closed loop system. **6**

b) Obtain C(S) | R(S) by using block diagram reduction technique. **10**

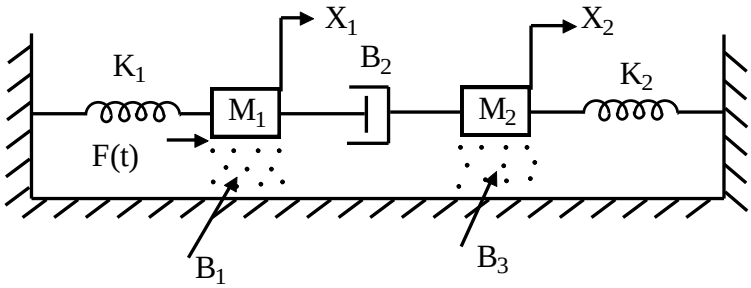


OR

2. a) Derive transfer function for following system by using SFG technique. **8**



b) Draw the mechanical network for the mechanical system shown in fig. Also draw force current analogous circuit. **8**



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3. a) What is the effect of reference input R(S) on steady state error (e_{ss}). **8**

b) A UFB system has $G(S) = \dfrac{10(S+1)}{S^2(S+2)(S+10)}$ **8**

Determine :

i) type of system

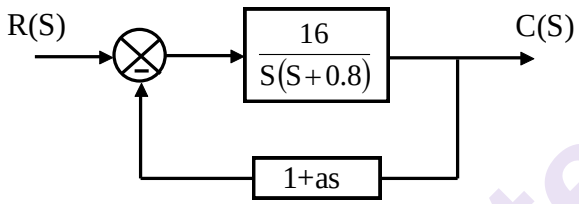
ii) error constants

iii) steady state error for $r(t) = 1 + 4t + \dfrac{t^2}{2}$

OR

4. a) A system has $G(S)H(S) = \dfrac{K}{S(S+2)(S+4)(S+8)}$ determine range of 'k' for stability. **8**

b) For the given system find value of 'a' such that damping ratio is 0.5. Determine rise time, peak time, settling time & max^m overshoot for unit step input. **8**



5. a) Define gain margin, phase margin, gain crossover frequency & phase crossover frequency. **4**

b) Given $G(S)H(S) = \dfrac{12}{S(S+1)(S+2)}$ Draw the polar plot and hence determine if system is stable & its gain margin & phase margin. **12**

OR

6. For a UFB system having $G(S) = \dfrac{K}{S(S+2)(S+10)}$ Determine value of 'k' which will make system marginally stable using bode plot. **16**

7. a) Explain Nyquist stability criterion & write its advantages. **6**

b) Draw Nyquist plot for $G(S)H(S) = \dfrac{K(S+3)}{S(S-1)}$ & hence comment on stability. **10**

OR

8. a) Explain the method to determine break away point in root locus. **4**

b) Sketch the root locus for a UFB system with $G(S) = \dfrac{K(S+1)}{S(S-1)}$ prove that the part of root locus is a circle. **12**

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9. a) Derive transfer function for Lag-lead compensator. **8**

b) Obtain controllability & observability of following system. **8**

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 \\ 0 & -2 & 1 \\ 0 & 0 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ -2 \end{bmatrix} [u]$$

$$y = [1 \quad 0 \quad 0] \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

OR

10. a) The CLTF of the system is given below : **10**

$$\frac{C(S)}{R(S)} = \frac{24}{(S+1)(S+2)(S+3)}$$

Find two different state models for the system.

b) Derive the expression for transfer function from state model. **6**

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