B.E.(with Credits)-Regular-Semester 2012 - Instrumentation Engineering Sem IV

IN402 - Feedback Control Systems

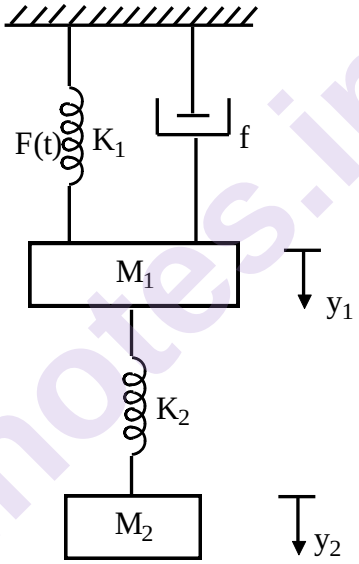
P. Pages : 3 **GUG/W/16/3918**

Time : Three Hours * 4 0 3 3 * Max. Marks : 80

Notes : 1. Same answer book must be used for all questions.
2. All questions carry marks as indicated.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Describe an example of a closed -loop control system & open loop control system. **8**

b) Find the force -current analogy of the following system. **6**

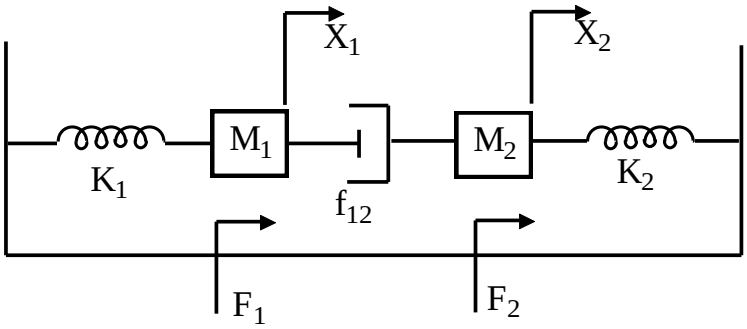


c) Explain the role of feedback in control system in reduction of parameter variations. **2**

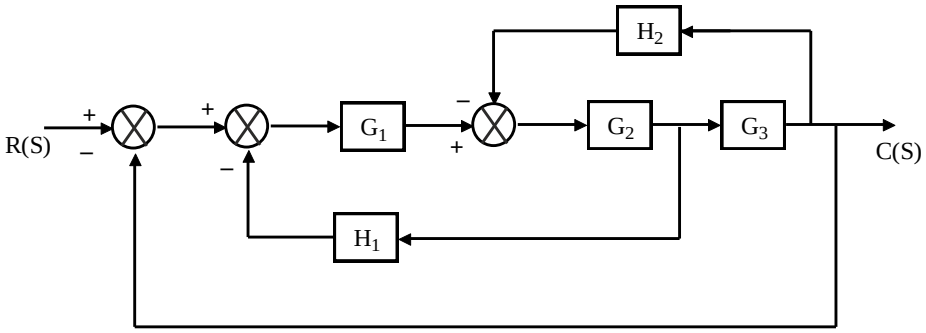
OR

2. a) Obtain the transfer function of liquid level system. **8**

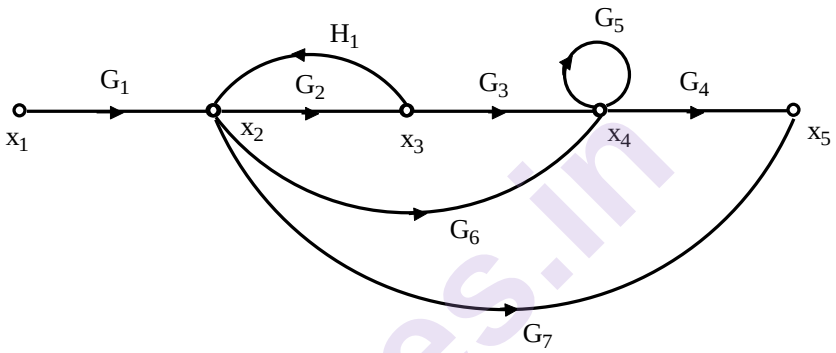
b) Write the differential equations for the mechanical system shown below. Also obtain an analogous electrical circuit based on force current analogy. **8**



3. a) Find $C(s)/R(s)$ using Mason's gain formula. **8**

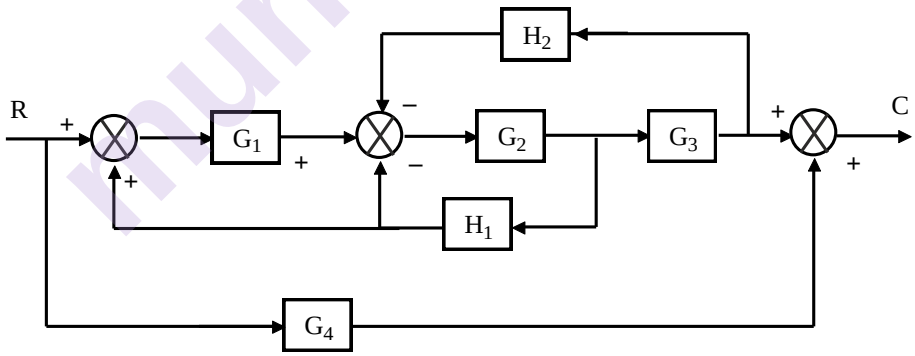


b) Determine the ratio X_5/X_1 using Mason's gain formula for SFG. **8**



OR

4. a) Find the transfer function for the block diagram shown in figure. **8**



b) Construct the signal flow graph for the following set of simultaneous equations. & obtain the transfer function. **8**

$X_2 = A_{21}X_1 + A_{23}X_3$

$X_3 = A_{31}X_1 + A_{32}X_2 + A_{33}X_3$

$X_4 = A_{42}X_2 + A_{43}X_3$

5. a) For a unity feedback, system given by $G(s) = 20(s+2)/s(s+3)(s+4)$. **8**
Find static error constants, steady state error for r(t) = 3 u (t) + 5t u (t)

b) Define pole and Zeros. **2**

c) Explain & define time domain specifications with neat diagram. **6**

OR

6. a) A system has performance equation. $\ddot{c}(t)+5\dot{c}(t)+16c(t)=9\ r(t)$. Find all the time response specifications and an expression for output if input is unit step. **8**

b) Obtain the transfer function of standard second order response for the unit step input. **8**

7. a) Define stability and its types. Also explain Routh Hurwitz criterion in brief with different cases. **5**

b) The open loop transfer function of a unity feedback control system is given by. **8**

$$G(s)=\frac{K}{(s+2)(s+4)(s^2+6s+25)}$$

by applying the Routh criterion, discuss the stability of the closed loop system as a function of K.
Determine the value of K which will cause sustained oscillations in the closed loop system?

c) Define relative & absolute stability. **3**

OR

8. a) Sketch the Root locus for a unity feedback system with **8**

$$G(s)\,H(s)=\frac{K(s+3)}{(s^2+4s+9)}$$

b) Show that a part of the root locus of a system with $G(s)=\frac{(s+3)}{s(s+2)}$, H(s) = 1 is circular. **8**

9. a) For a unity feedback system, $G(s)=\frac{10(s+1)(s+2)}{(s+4)(s^2+6s+8)}$ Sketch the Bode plot and find G. M. and P. M. of system. **8**

b) Explain Nyquist stability criterion & its significance. **5**

c) Explain relationship between time domain & frequency domain specifications. **3**

OR

10. a) Sketch Bode plots for the following. **8**

$$G(s)H(s)=\frac{10(s+4)}{s(s+1)(s+5)}$$

Determine the gain cross over freq. phase margin & gain margin, comment on stability of system.

b) Draw the polar plot for the closed loop system having the following open loop transfer function & determine whether the system is stable or not **8**

$$G(s)\,H(s)=\frac{100}{s(1+2s)(1+s)}$$

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