B.E. / B.Tech. Instrumentation Engineering (Model Curriculum) Semester-IV

IN403M / IN403 - Automatic Control System

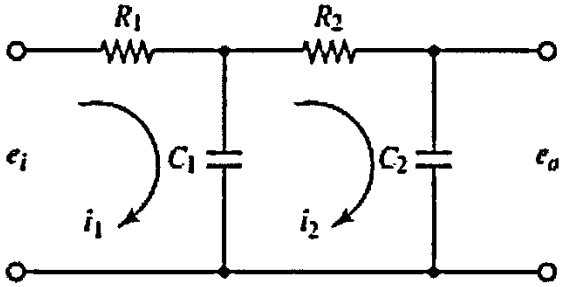
P. Pages : 3 **GUG/S/25/14016**

Time : Three Hours * 2 3 5 6 * Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Illustrate your answers wherever necessary with the help of neat sketches.

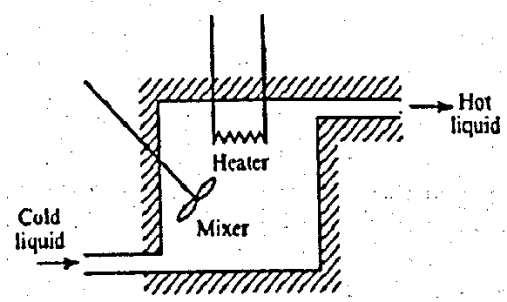
1. A) Differentiate between open loop control system and closed loop control system also specifies examples of open loop and closed loop system. **8**

B) Find out transfer function $E_o(s) / E_i(s)$ of given network. **8**

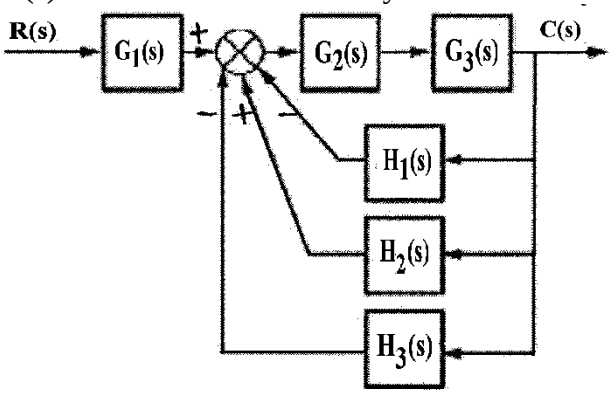


OR

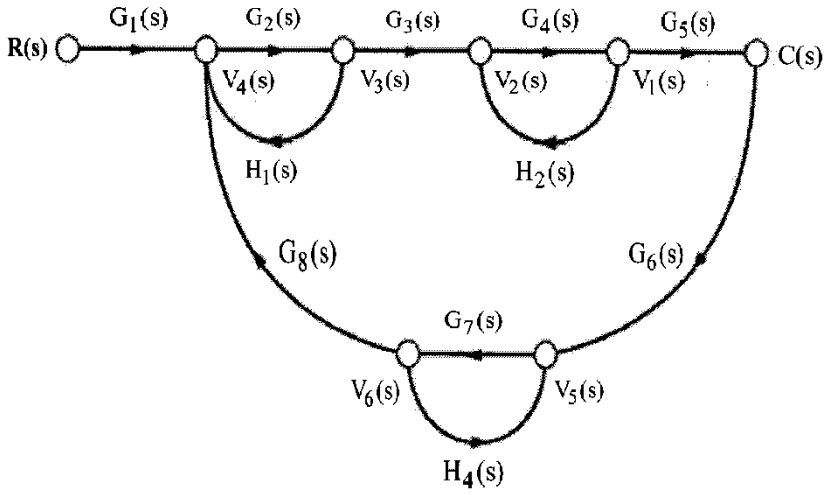
2. A) Do the mathematical modeling for thermal system shown in figure and find its transfer function.



B) Draw the basic block diagram of closed loop control system and derive the closed loop transfer function C(s)/R(s). List effect of feedback system. **8**



B) Find the Transfer Function C(s)/R(s) for given SFG using Masson's gain formula. **8**



OR

4. A) Construct a signal flow graph from given set of equation and hence determines transfer function. **8**

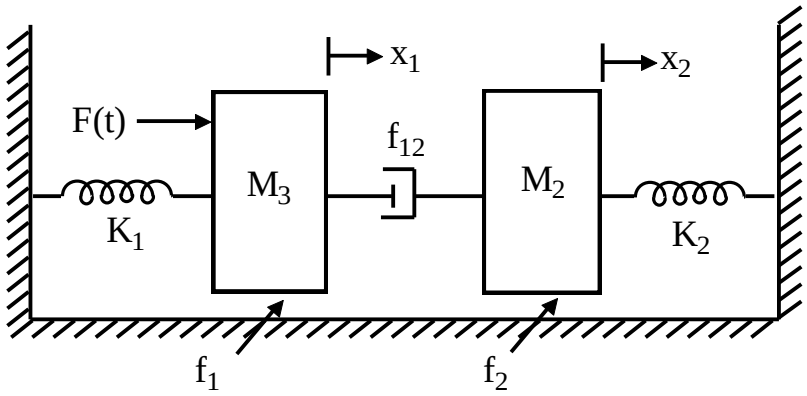
$x_2 = a_{12}x_1 + a_{32}x_3 + a_{42}x_4 + a_{52}x_5$

$x_3 = a_{23}x_2$

$x_4 = a_{34}x_3 + a_{44}x_4$

$x_5 = a_{35}x_3 + a_{45}x_4$

B) Write the differential equations for the mechanical system shown in figure. Also obtained the analogous electrical circuit based force current analogy. **8**



5. A) Consider a unity feedback system with a closed loop transfer function C(s)/R(s) = (Ks+b) / (s^2+as+b). Determine the open loop transfer function G(s). Show that the steady state error with unit ramp input is given by (a-K) / b. **8**

B) Determine the output response of a standard second order system for step input. **8**

OR

6. A) The overall transfer function of unity feedback control system is given by C(s) / R(s) = 10 / (s^2+6s+10). Find the K_p, K_v, K_a as well as steady state error if the input is **8**

$r(t) = 1 + t + t^2$.

B) A unity feedback system has forward path transfer function with input r(t) = 1+5t is given by G(s)= K(2s+1) / s(4s+1)(s+l)^2(s^2+2s+3). It is desired that the steady state value of error be equal to or less than 0.1. Determine minimum value of K to satisfy this requirement. **8**

7. A) Examine the stability of the system by Routh's criteria having characteristic equation **8**
$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$

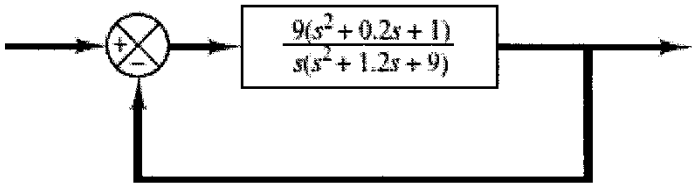
B) Plot the root loci for the closed loop control system with $G(s) = K(s+1)/s^2$, $H(s) = 1$ **8**

OR

8. A) Determine stability of the system whose characteristics equation is given by **8**
$S^5 + 2s^4 + 24s^3 + 48s^2 - 25s - 50 = 0$ using Routh's criteria. Comment on the location of poles in S plane.

B) The transfer function of unity feedback system is given by **8**
C(s)/R(s) = K(s+l) / s^4 + 2s^3 + 2s^2 + (2+K) s + K. Determine the range of K for stable operation of system and find K which yields marginal roots and value of these roots. Plot the root loci for the closed loop control system with G(s) = K(s+0.2)/s^2(s+3.6), H(s) = 1

9. A) Consider the system shown in Figure. The open-loop transfer function is **8**
G(s) = 9(s^2 + 0.2s + 1)/ S(s^2 + 1.2s + 9). Plot a bode diagram.



B) Derive State Space model from Transfer Function. **8**

OR

10. A) Consider following open loop transfer function $G(s) = 25/s^2 + 4s + 25$. Draw the bode plot for this transfer function. **8**

B) Briefly explain the State Model of the Systems. **8**

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