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

IN403 - Automatic Control System

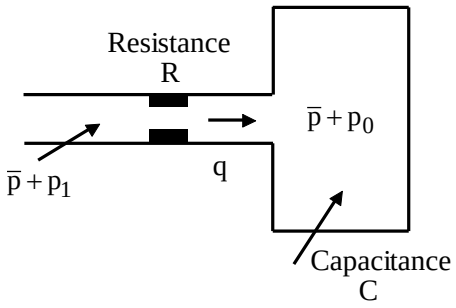
P. Pages : 3 **GUG/W/23/14016**

Time : Three Hours * 7 6 0 3 * Max. Marks : 80

Notes : 1. Same answer book must be used for each section.
2. All questions carry marks as indicated.
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.

1. a) List advantages and disadvantages of open loop control system and closed loop control system. Differentiate between open loop control system & closed loop control system with an example. **8**

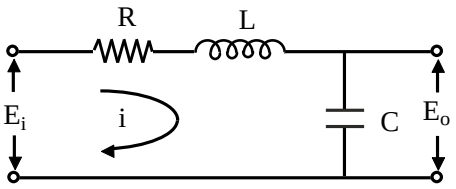
b) Do the mathematical modeling of pneumatic system shown in figure and find its transfer function. **8**



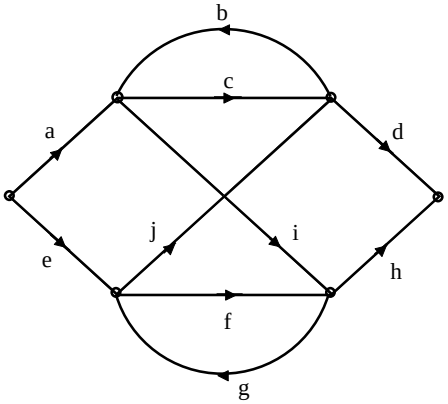
OR

2. a) Discuss the types of feedback & effects of feedback. **8**

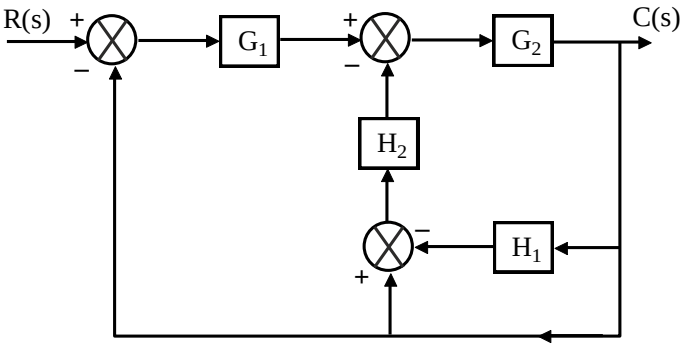
b) Find out transfer function of given network. **8**



3. a) Find the transfer function Y(s)/X(s) for given SFG using Masson's gain formula. **8**

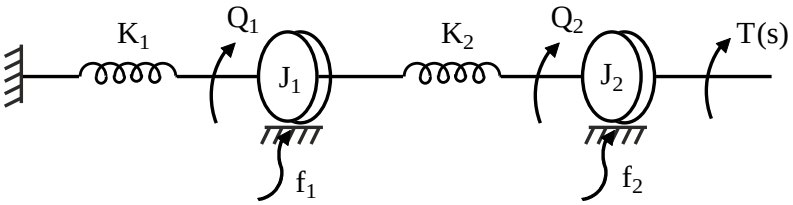


b) Reduce the following block diagram and evaluate the overall transfer function. **8**

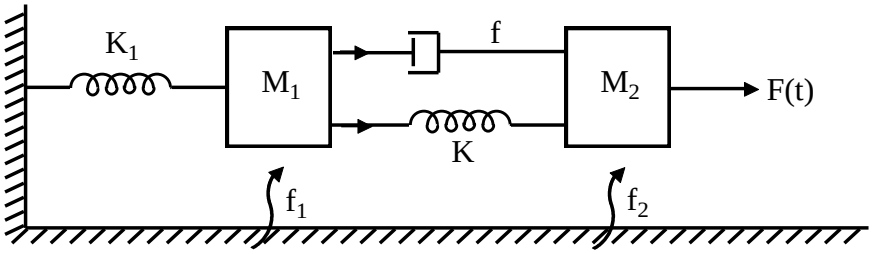


OR

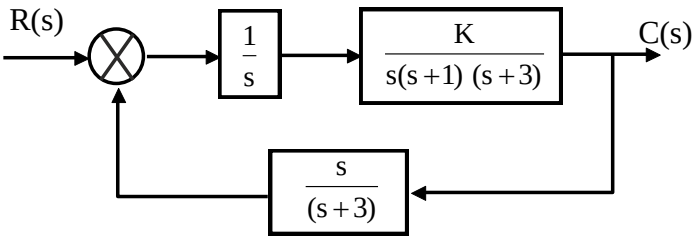
4. a) For the system shown below write down the governing differential equations and hence determine the transfer function $Q_2(s)/T(s)$. **8**



b) Obtain T.F. $\frac{X(s)}{F(s)}$ of mechanical system. **8**



5. a) Determine the order & type of system represented by block diagram shown below. **8**



b) A unity feedback system having $G(s) = \frac{10(s+1)}{s^2 + (s+2)(s+10)}$. Determine steady state error for the μp $r(t) = 1 + 4t + t^2$. **8**

OR

6. a) For the unity feedback system having forward path transfer function $G(s) = \frac{50}{s(s+2)}$. **8**

Determine the unit impulse response and number of oscillations (Nd) before settling, sketch output response to scale.

b) The error response of a second order unity feedback control system is given by **8**
$e(t) = 1.805e^{-3t} \sin(2t + \cos^{-1} 0.832)$ find closed loop T.F. and number of cycles before settling (Nd).

7. a) Examine stability of the fourth order system having characteristic equation **8**
$s^4 + 2s^3 + 6s^2 + 10s + 3 = 0$.

b) A certain control system with unity f/b have open loop transfer function **8**

$$G(s)\,H(s) = \frac{K_1}{s(1+0.02s)\,(1+0.01s)}$$

i) Draw root locus diagram of system.
ii) Determine K_1 that just make system unstable.

OR

8. a) Find stability of the system by Routh's criteria. The system characteristic equation is **8**
$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$.

b) A feedback control system has open loop transfer function **8**
$G(s)\,H(s) = \frac{k(s+1)}{s(s+1)\,(s^2+4s+16)}$ sketch the root locus of the system.

9. a) Write general procedure for constructing Bode plots. Draw the Bode plot for the transfer function. **8**

$$G(s) = \frac{64(s+2)}{s(s+0.5)\,(s^2+3.2s+64)}$$

b) Derive the transfer function from general state model: **8**

$$X = Ax + Bu$$

$$Y = Cx + Du$$

OR

10. a) A unity feedback system has a plant transfer function of $G(s) = \frac{K(s+4)}{(s-1)\,(s-2)}$ for k = 8 **8**
draw the Bode plots and find therefrom the phase margin and gain margin.

b) "Transfer function is unique and state variable is non-unique", Justify the statement. Also define state variables, state, state vector and state space. **8**

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