B.E. Instrumentation Engineering (MODEL CURRICULUM) Sem-IV

# IN403M : Automatic Control Systems

P. Pages : 2 **GUG/W/22/14016**

Time : Three Hours * 3 2 4 5 * Max. Marks : 80

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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. Diagrams and Chemical equation should be given wherever necessary.
6. Illustrate your answers wherever necessary with the help of neat sketches.

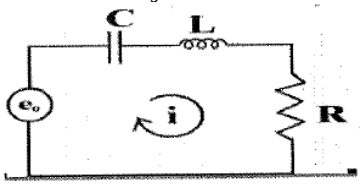
**1.** a) Obtain the transfer function of field control DC motor, mention the assumptions required. **8**

b) Discuss open loop and closed loop control system with at least two examples of each system. **4**

c) Write the difference between open loop and closed loop control system. **4**

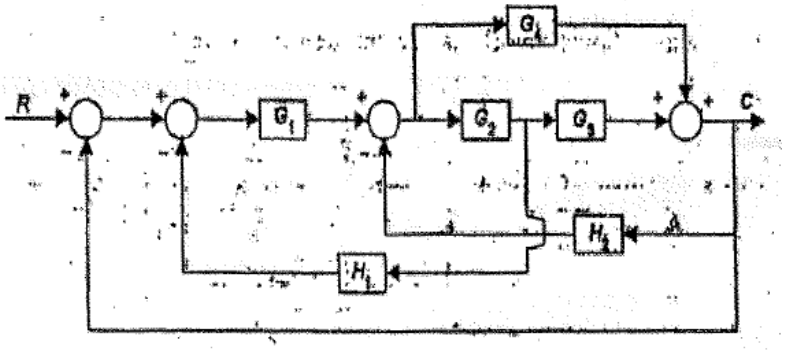
**OR**

**2.** a) Derive transfer function for the Electrical system shown in Figure below. **8**




b) Compare the pneumatic system with liquid level system. **8**

**3.** a) Find the ratio C(S)/R(S) of the system using block diagram reduction technique. **8**

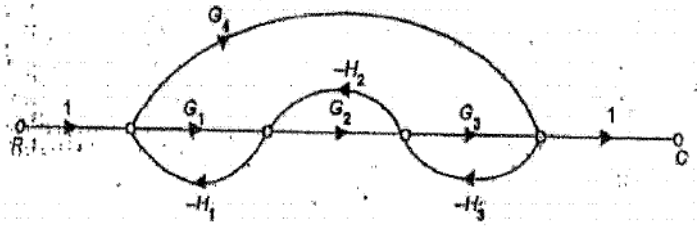



b) Write down the steps involved for construction of signal flow graph. **4**

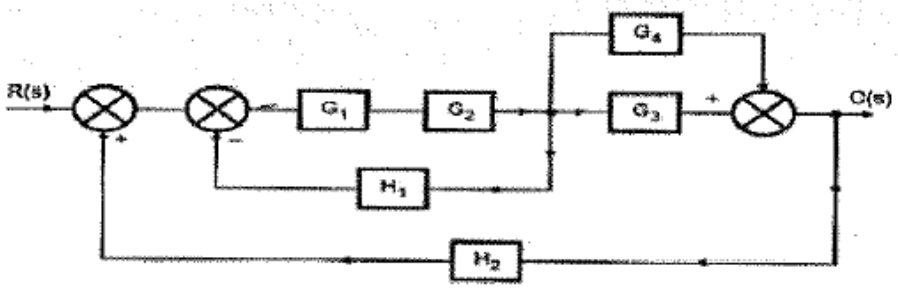
c) Derive the expression of closed loop transfer function. **4**

**OR**

**4.** a) Solve with the masons gain formula as shown. **8**



b) Derive the transfer functions of the system using signal flow graph. **8**




**5.** a) A control system having UFB as $G(s) = K(s+2)/s(s^3+7s^2+12s)$ Find: i) Type and order of system ii) Error constants iii) Steady state error for $r(t) = 1+2t+1.5t^2$. **8**

b) Define the following term **4**
i) Rise Time. ii) Delay Time. iii) Settling Time. iv) Peak Overshoot

c) Derive an expression to find steady state error of a closed loop control system. **4**

**OR**

**6.** a) A unity feedback control system is characterized by the following open loop transfer function $G(s) = \frac{(4s+1)}{s(s+6)}$. Determine its transient response for unit step input and sketch the response. **8**

b) Determine the type and order of the system with following transfer function **8**

i) $G(s) = \frac{(s+4)}{(3+s)(s-2)}$ ii) $G(s) = \frac{10}{s^3(s^2+2s+1)}$

**7.** a) The open loop transfer function of UFB is K/S(1+0.4S)(1+0.25S). Find the restriction of K so that the closed loop system is absolutely stable. **8**

b) Write a short note on: **4**
i) Asymptotic stability ii) Relative stability

c) Define stability and state Routh's criterion for stability and also note down the effect of adding pole zero's on stability. **4**

**OR**

**8.** a) Show that the part of the root locus of a system with G(S)=(S+3)/S(S+2), H(S)=1 is circle. **8**

b) Construct R-H criterion and determine the stability of a system representing the characteristics Equation $S^3+S^4+2S^3+2S^2+3S+5=0$. Comment on location of the roots of the characteristics Equation. **8**

**9.** a) Describe the Nyquist contour and its various segments. **4**

b) Define the following terms: **4**
i) Gain Margin ii) Phase Margin
iii) Gain crossover frequency iv) Phase crossover frequency

c) Sketch the bode plot. **8**
G(S)=512(S+3)/S($S^2$+16S+256)

**OR**

**10.** a) Draw the polar plot for the closed loop system having the following open loop transfer function and determine whether the system is stable or not. **8**
G(S) H(S) = 100/S(1+2S) (1+S)

b) Sketch the bode plot. Find G.M. and P.M. comment on closed loop system stability. **8**
G(S)=288 (S+4)/S(S+2) ($S^2$+4.8S+144)

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