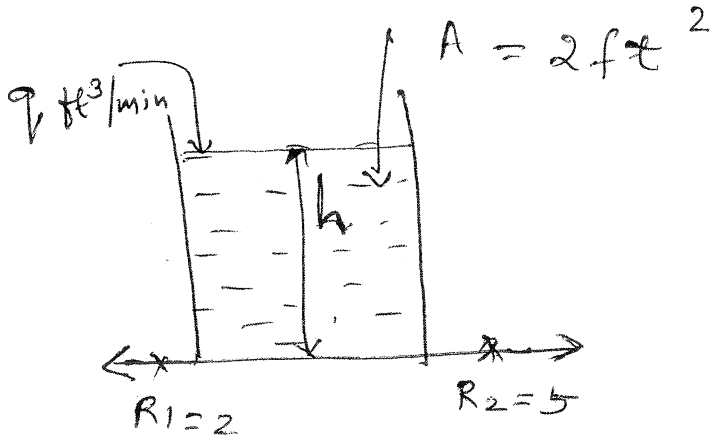
[3 Hours] [Total Marks : 80]

N.B : 1. Question No. 1 is **compulsory**.
2. Answer any four questions from the remaining.
3. Assume suitable data if necessary.
4. Answer of the sub-questions of an individual questions should be grouped and written together.

1. (a) Discuss in brief about an overview of control system design ? **5**
(b) (i) Derive the dynamic model of stirred tank heating process, assuming constant hold up and perfect mixing. **10**
(ii) Classify the variables and carryout a degrees of freedom analysis.
(c) Explain Gain margin and phase margin. **5**

2. (a) A two tank mixing process is initially operating under steady state conditions, with a volumetric flow rate of $2m^3/min$ of a solution. The solute concentration is $1kg/m^3$. The volume of the first tank is $4m^3$ and that of the second tank is $6m^3$. At time $t = 0$, the solute concentration in the inlet to the first tank suddenly increases to $2kg/m^3$. How long does it take for the solute concentration in the outlet from the second tank to reach $1{\cdot}6\ Kg/m^3$. **10**

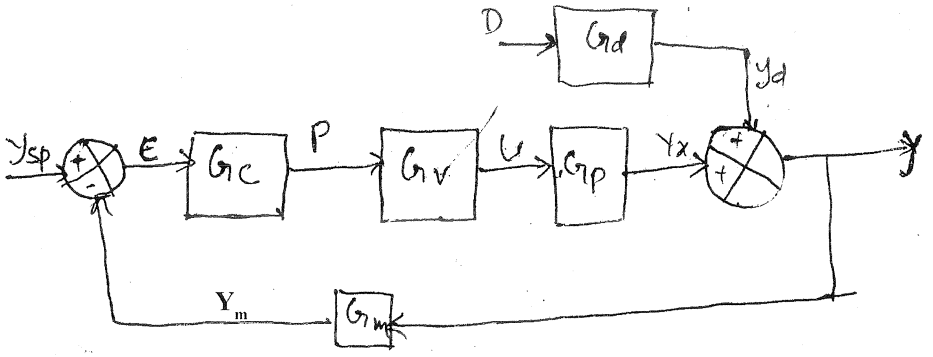
(b) **10**



Derive the transfer function $\frac{H}{Q}$ for the liquid level system shown in fig. The resistance are linear. H and Q are deviation variables. You are expected to give numerical values in the transfer functions.

3. (a) What conditions must be satisfied by a two tank non-interacting system to exhibit a critically damped response. **5**

(b) 10



Block diagram for Control system

Consider the feedback control system shown in figure above with the following transfer functions : $G_c = K_c$, $G_v = \frac{1}{2s+1}$, $G_p = G_d = \frac{1}{5s+1}$ $G_m = 1$. Determine the range of K_c values that result in a stable closed loop system.

(c) A second order system is found to have a peak amplitude ratio of 1·1547 at a frequency of 0·7071 rad/min. What are the values of time constant and the damping coefficient of the system. 5

4. (a) A unity feed back system has 15

$$G(s)\ H(s) = \frac{80}{s(s+2)\ (s+20)}$$

Draw the Bode plot. Determine the G.M., P.M., w_{gc}. w_{pc}. Comment on the stability?

(b) Discuss the guidelines for the selection of controlled manipulated and measured variables. 5

5. (a) Discuss the continuous cycling method for online controller tuning. 10
(b) Write down the rule for plotting root locus diagram. 5
(c) Discuss in brief control valve characteristics. 5

6. (a) The following response was obtained from a dynamic system when a step of magnitude 0·2 was introduced. 10

Time	Response
0	0·00000
5	0·001757
10	0·025273
15	0·88674
20	0·178158
25	0·268563
30	0·343173
35	0·396964
40	0·432176
45	0·453617

Finally the response approaches constant value of 0·4798 after a long time. Use the data to fit the first order plus dead time model to the systems.

(b) Explain Niquist - stability criteria in detail. 10