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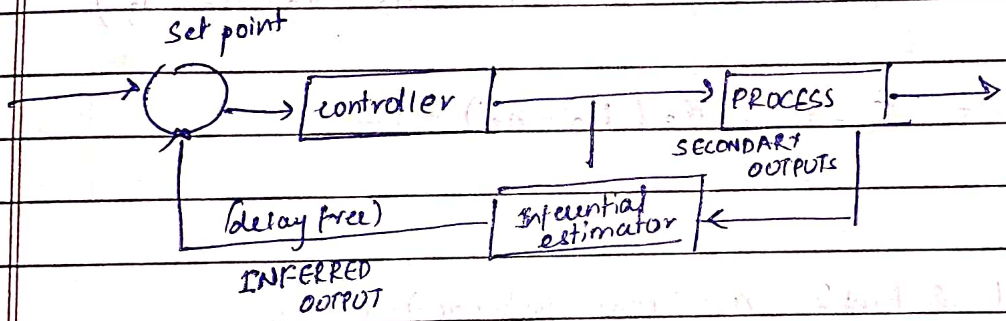
Inferential control : infeerential control is based an estimate of the controlled variable

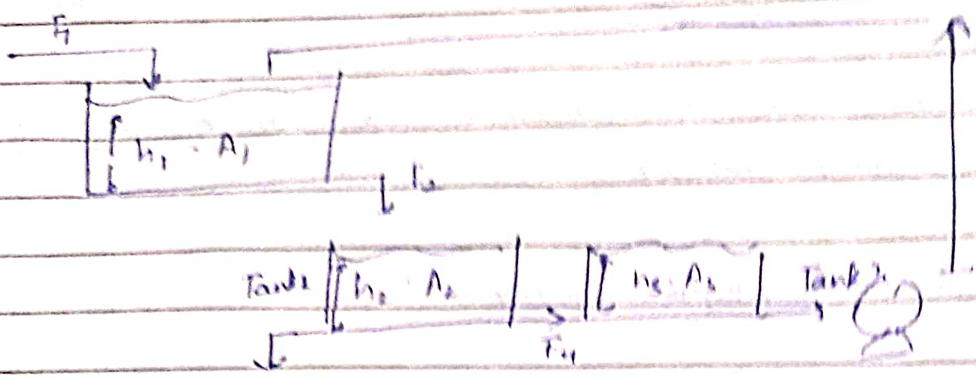
Eg: emperical relation, kalman filter.

- Infeential controls is needed, when the controlled variable are difficult to measure. Hence these variables are estimated from some easy to measure process variable and then used in feedback control.



Infeential	Standard
→ In infeential control ~~the~~ some variables are estimated and not measured	→ In standard control all the variables are measured
→ Infeential control calculate difficult to measure value and is then used to send to feedback control.	→ Feedback control is an independent control.

Q2)



Using principle of mass conservation assuming density is constant

$$A_1 \frac{dh_1}{dt} = F_1 + F_3 - F_2 = F_1 + F_3 - \alpha h_1$$

$$A_2 \frac{dh_2}{dt} = F_2 - F_3 - F_4 = -\alpha_1 h_1 - \alpha_2 h_2 - \alpha_3 (h_2 - h_3)$$

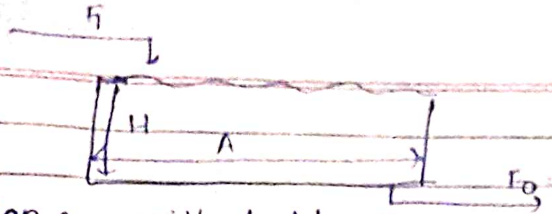
$$A_3 \frac{dh_3}{dt} = F_4 - F_3 = \alpha_3 (h_2 - h_3) - F_5$$

[∵ tank 1 & tank 2 are non Interactive and tank 2 & Tank 3 are Interactive.

Q3) ~~St~~ DOF = Total number of independent variables − number of equation

$= 5 - 3$

$= 2.$



Q4) Mass balance will hold the max non linear dynamic model

$$A\frac{dh}{dt} + \beta(h)^{1/3} = F_1$$

Take taylor series expansion about ho

$$\beta(h)^{1/3} = \beta(h_o)^{1/3} + \left[\frac{d}{dh}\beta(h_o)^{1/3}\right]_{h=h_o}(h-h_o)$$

$$+\left[\frac{d^2}{dh^2}\beta(h)^{1/3}\right]_{h=h_o}\frac{(h-h_o)^2}{L2}$$

$$= \beta(h_o)^{1/3} + \frac{1}{3}\beta(h_o)^{-2/3} - \frac{2}{9}\beta(h_o)^{-5/3}$$

$$\cong \beta(h_o)^{1/3} + \frac{1}{3}\beta(h_o)^{-2/3}(h-h_o)$$

$$\therefore A\frac{dh}{dt} + \beta(h_o)^{1/3} + \frac{1}{2}\beta(h_o)^{-2/3}(h-h_o) = F_1$$

Q5) $$A\frac{dh}{dt} + (\beta\cdot h_o)^{1/3} + \frac{1}{3}\beta(h_o)^{-2/3}(h) - \frac{1}{3}\beta h_o^{1/3} = F_1$$

$$A\frac{dh}{dt} + \frac{1}{3}(\beta h_o^{-2/3})h = F_1 - \frac{2}{3}\beta h_o^{1/3}.$$

$$\tau \frac{dx}{dt} + x = k f_2(t)$$

Time constant $\tau = \dfrac{A}{\left(\frac{1}{3}\beta h_0^{-2/3}\right)} = \dfrac{3 A h_0^{2/3}}{\beta_0}$

Static gain $= \dfrac{1}{\frac{1}{3}\beta h_0^{-2/3}} = \dfrac{3 h_0^{2/3}}{\beta}$

$\therefore$ Thus time constant and static gain is variable.