

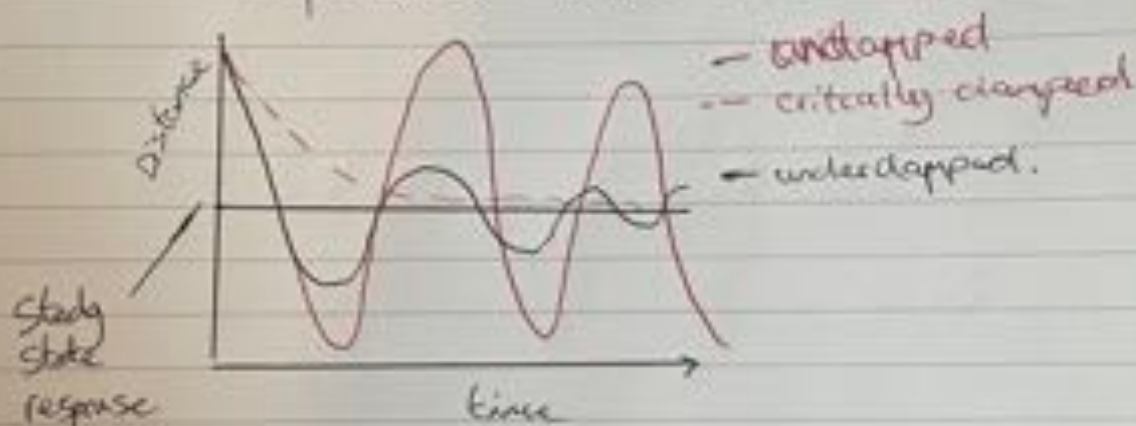
Ryan Williams 1908507

(8)

3c

$\tilde{y}(t)$ = transient response occurs as a result of change in system output input - dies away after time

$\bar{y}(t)$ = steady state response that remains after all transient responses have died down



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(7)

3A $G = 15 \times 0.35$

$G = 5.25$

$\text{ESS} = 0$

Find H $\text{ESS} = 0, \left(\frac{G}{1+GH} - 1 \right)$

for zero ESS $\frac{G}{1+GH} = 1$

$\therefore \frac{5.25}{1+5.25H} = 1$

$\therefore 1+5.25H = 5.25$

$H = \frac{4.25}{5.25}$

$H = \underline{\underline{0.81}}$

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⑥

2d $G_1 = 10 \text{ mV}$ $G_2 = 2.5 \text{ mm/mm}$ $H = 0.15 \text{ s}$

$$\frac{\theta_o}{\theta_i} = \frac{G_1 G_2}{1 + (G_1 G_2 H)}$$

$$\frac{\theta_o}{\theta_i} = \frac{10 \times 2.5}{1 + (10 \times 2.5 \times 0.15)}$$

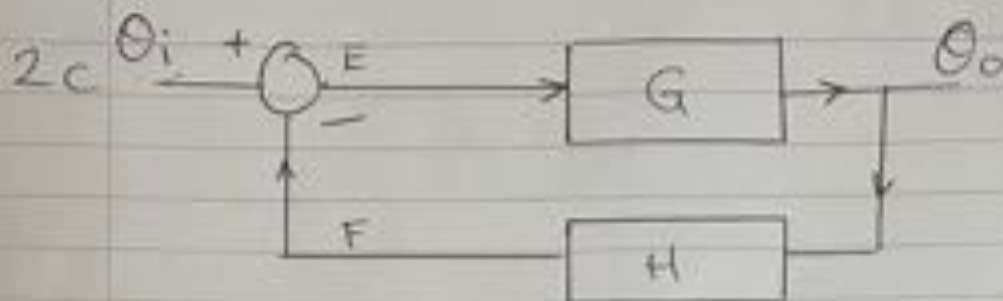
$$= \frac{25}{1 + 3.75} = 4.75 \text{ mm/mm}$$

2E speed control of conveyor belt
temperature control of heat treatment
furnace

1968507

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⑤



$$G = \frac{\theta_o}{E} \Rightarrow E = \frac{\theta_o}{G}$$

$$H = \frac{F}{\theta_o} \Rightarrow F = H \times \theta_o$$

now $E = \theta_i - F$

$$\therefore \frac{\theta_o}{G} = \theta_i - H \times \theta_o \Rightarrow \frac{\theta_o}{G} + H \times \theta_o = \theta_i$$

so $\theta_o \left(\frac{1 + G \times H}{G} \right) = \theta_i$ hence $\frac{\theta_o}{\theta_i} = \frac{G}{1 + G \times H}$

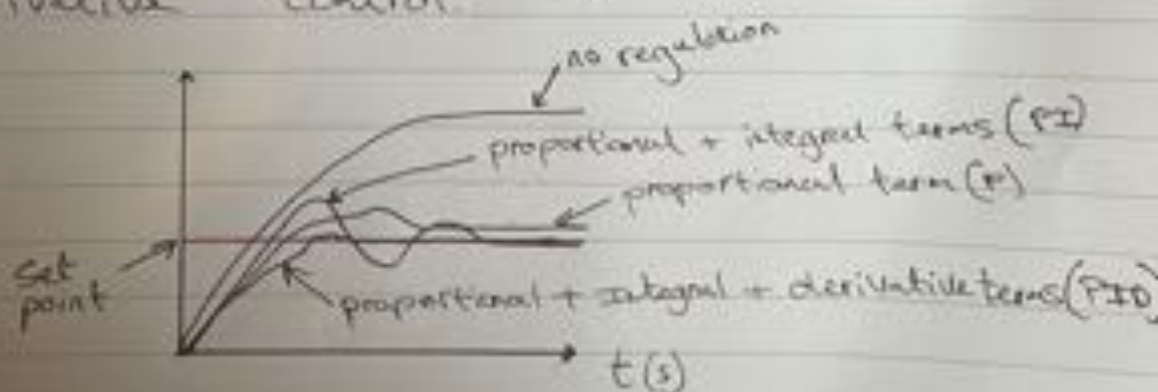
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2A a control system comprises of subsystems or element and processes assembled for the purpose of controlling the output of the processes

automatic process control requires no manual intervention to achieve desired output value. Automatic (closed loop) system self regulate but however this does make them more complex and expensive.

2B A PID controller is known as a 3 term controller because it features 3 control modes - no offset error reduces oscillations.

proportional control, Integral control and Derivative control



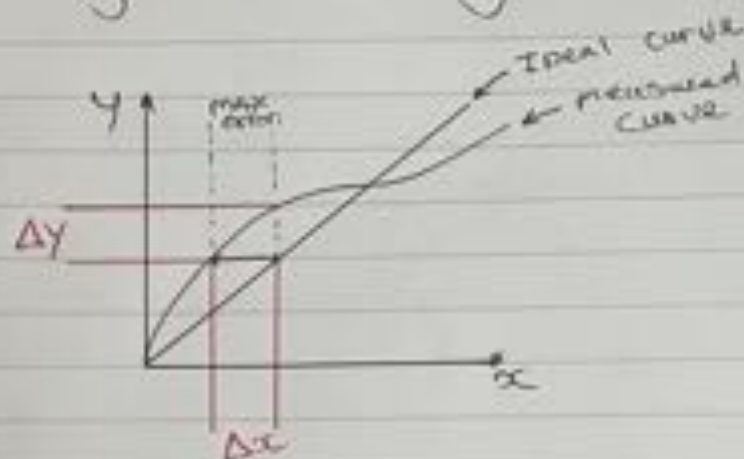
PID controllers are highly suited to controlling liquid flow or temperature.

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(3)

du Wheatstone bridge is possibly the signal conditioner of the system converting change in resistance to change in voltage

E



$$\text{non linearity in} = \frac{\Delta x}{x} \times 100\%$$

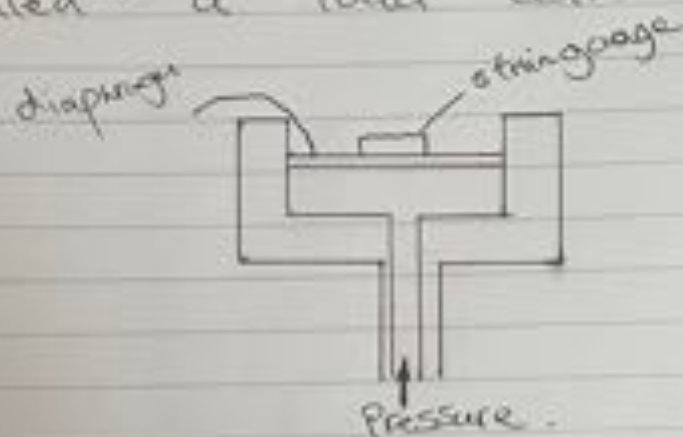
$$\text{non linearity out} = \frac{\Delta y}{y} \times 100\%$$

non linearity can be described as the ratio of measured output/input.

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(2)

- 1c A strain gauge may be used to also measure pressure as an example of this ~~is~~ can be a strain gauge used to measure the deformation of a diaphragm under pressure often called a load cell.



1d: overall sensitivity

$$K_1 \times K_2 \times K_3 \times K_4$$

$$(75 \times 10^3) \times (150 \times 10^3) \times 100 \times 1.78$$

$$0.075 \times 0.15 \times 100 \times 1.78$$

$$\text{Overall} = 2.0 \text{ mV/V}$$

$$11 \quad C/R = 2.0 \quad C = 12.75$$

$$\frac{12.75}{2.0} = 6.375 \text{ cm}$$

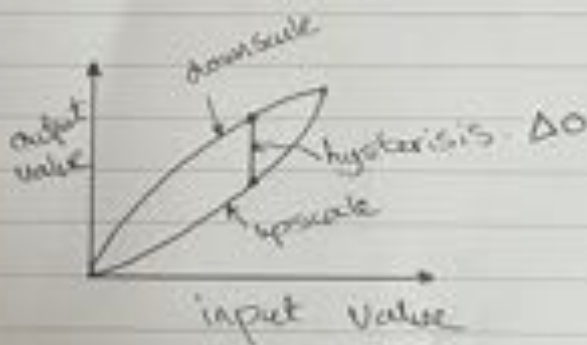
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①

- 1A the ideal relationship between the measurand and the transducer output would be zero error

Input = output.

- 1B Hysteresis error is maximum difference in output for increasing and decreasing values



hysteresis error can be plotted as a percentage of its full scale

$$\frac{\Delta o}{O} \times 100$$