

Q1A) MEASUREMENT is the quantification of an attribute i.e. temperature, dimension etc. $\therefore$ monitoring is recording of the measurements over time.

Q1B) Precision indicates how close a set of indicated values lie together, whereas, accuracy stated in terms of error from the expected value. Stability is the ability to display same reading on number of occasions when input applied over long period of time, repeatability is same but input applied over short intervals.

Q1C) A resistance strain gauge may be applied to a diaphragm being acted upon within a vessel. Change in length of gauge wire causes proportional change in resistance of device.

Q1D) $\frac{C}{R} = 0.75 \times 0.15 \times 500 \times 1.0$

$$\therefore \frac{C}{R} = 56.25 \text{ cm/rad.}$$

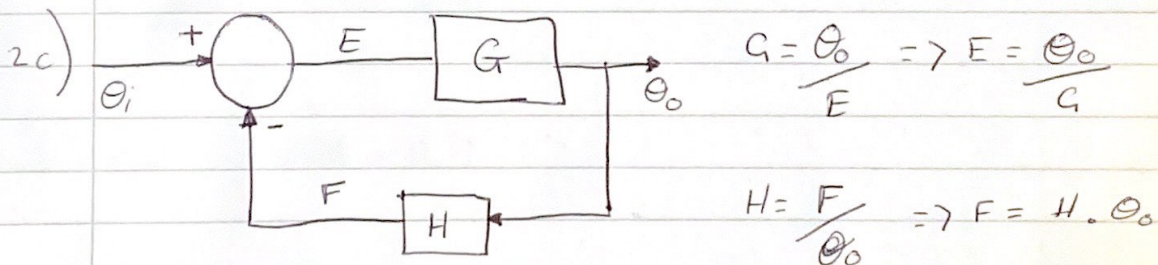
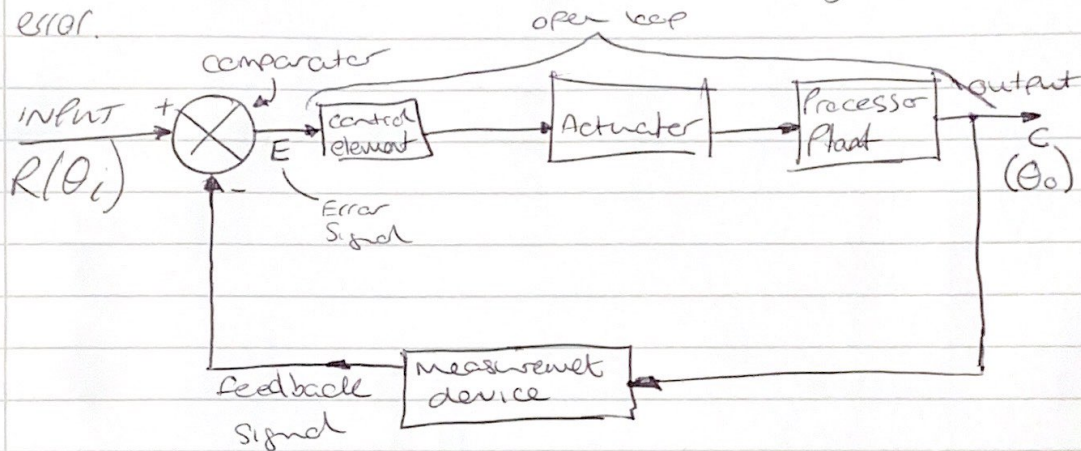
ii) Now $C = 8.5 \text{ cm} \Rightarrow R = \frac{8.5}{56.25} = 0.151 \text{ rad.}$

iii) Maximum deviation from linear input/output relationships overall expressed as % of value converting a resistance change to a voltage of a transducer. Unknown resistance is compared to known value of resistance.

Q2) A) Open loop has no error signal to account for differences in output value compared to desired output i.e. input value.

Closed loop has feedback signal and measurement system/device, as well as comparison element.

Closed loop generates error signal, closed loop can deal with system disturbance and has reduced steady-state error.



Now, $E = \theta_i - F$

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

$$\text{So, } \theta_o \left(\frac{1+GH}{G} \right) = \theta_i \quad \text{Hence, } \frac{\theta_o}{\theta_i} = \frac{G}{1+G \cdot H}$$

$$2d) \frac{\theta_o}{\theta_i} = \frac{G_1 \cdot G_2}{1 + G_1 \cdot G_2 \cdot H} = \frac{(5 \times 0.25)}{1 + (5 \times 0.25 \times 0.15)}$$

$$= \frac{1.25}{1.1875}$$

$$\therefore \frac{\theta_o}{\theta_i} = 1.053 \text{ mm/v}$$

- 2e) Temperature control of Heat treatment furnace
 • Speed control of conveyor belt.

3a) ~~Block~~ system d.e.;

~~1/s~~

$$3a) \frac{\theta_o}{\theta_i} = \frac{15 \times 0.35}{1 + (15 \times 0.35)} = \frac{5.25}{6.25}$$

$$\frac{\theta_o}{\theta_i} = 0.84 \text{ rpm/v}$$

$$3a) \text{ii) now } G = \frac{15}{6.25} \times 0.85$$

$$3b) a_1 = RC, a_0 = 1 \text{ and } b_0 = 1,$$

$$P_c = P[1 - e^{(-\frac{t}{RC})}] \quad \therefore RC \frac{dP_c}{dt} + P_c = P$$

