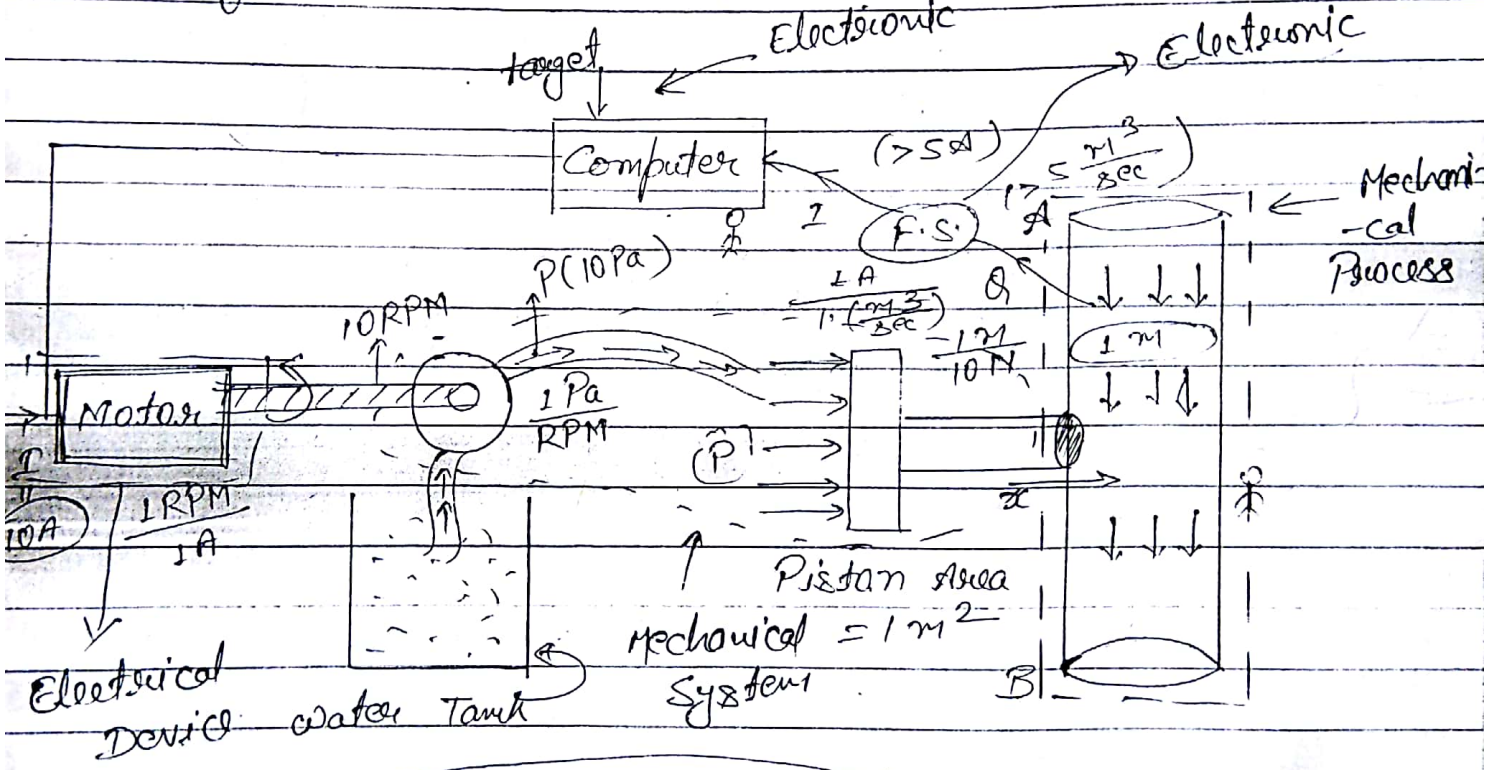
DATE
31/10/2016

Mechatronics :—

Integration of electrical & electronic devices in the mechanical system leads to the development of Mechatronics Technology.

In Mechatronics Engineering we generally control Mechanical variable in Mechanical Process with the help of Electrical Devices and Electronic sensors & Processors.

Consider the example where Flow should be shut down, if the flow rate of the water is greater than $5\ m^3/s$.



Flow rate of water Q $\left(\frac{m^3}{sec}\right)$

9:00:00 AM : Q = $5\ m^3/sec$)

10:00:00 AM ; Q = $5\ m^3/sec$

11:00:00 AM ; Q = $5\ m^3/sec$

> 11:00:00 AM ; Q > $5\ m^3/sec$

Q = $10\ m^3/sec$

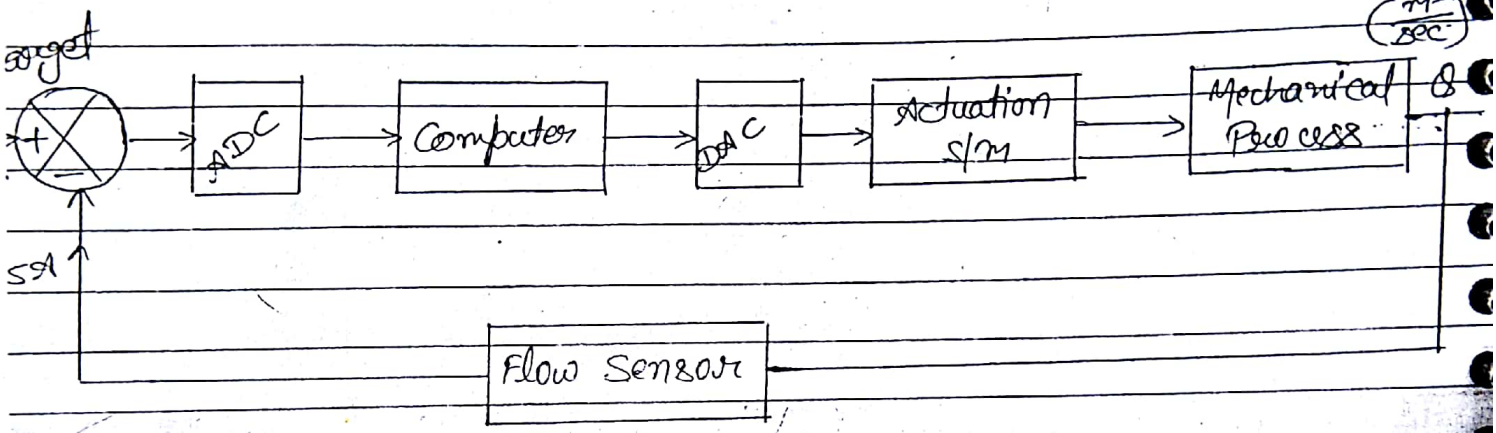
⇒ Shut down the flow

$x = 1\ m$; Force required = 10N

Pressure required = F/A

$= \frac{10N}{1m^2} = 10\left(\frac{N}{m^2}\right) = 10\ Pa$

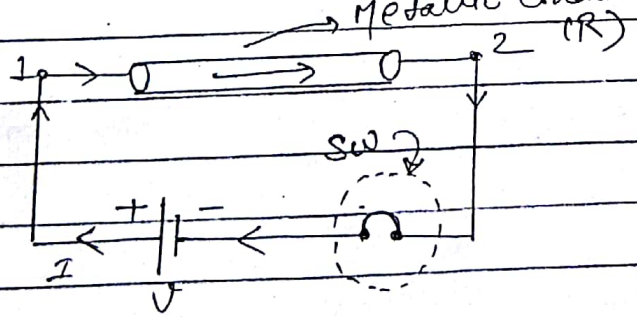
Block Diagram of Mechatronics Engineering :-

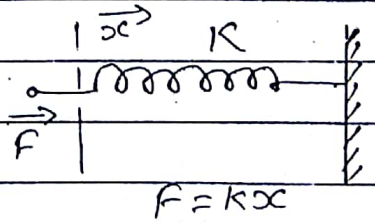


⇒ Every application in mechatronics engg, by default consist control action.

Basics of Electricity :-

→ Flow of charge / electron through a medium.





Consider a electric loop shown above.

$V = RI$ (at Cnst. Temp.)

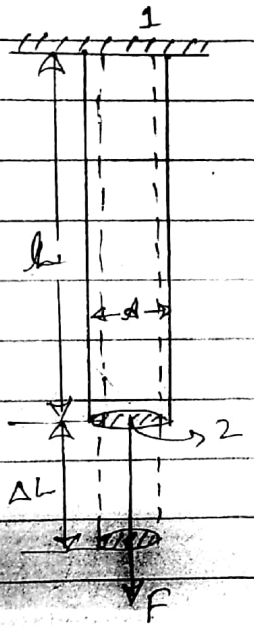
$I = \frac{V}{R}$ If $R \uparrow\uparrow$; $I \downarrow\downarrow$

If $R \downarrow\downarrow$; $I \uparrow\uparrow$

The direⁿ of the current can be changed by changing the Polarities of the battery.

Strain Gauge :-

Strain gauge is a metallic or semiconductor based resistive sensor, which changes its resistance bcz of the applied load. Consider a metallic wire, where one end is fixed and other end is free as shown below.



$$R = \frac{\rho l}{A}$$

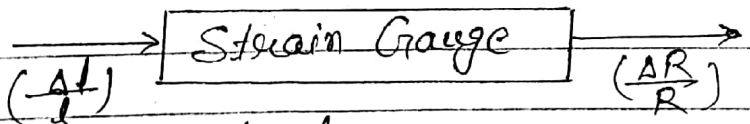
$$R = f(\rho, l, A)$$

F↑ → Δl↑ → lω↑ → R↑

F↑ → I↓

@ ← F → $\frac{F}{A}$

F → ε



$\Delta R \propto \Delta l$

$\left(\frac{\Delta R}{R}\right) \propto \left(\frac{\Delta l}{l}\right)$

$\left(\frac{\Delta R}{R}\right) = K \cdot \left(\frac{\Delta l}{l}\right)$

$\frac{\left(\frac{\Delta R}{R}\right)}{\left(\frac{\Delta l}{l}\right)} = K = G_f$

$\frac{\Delta R}{R} = G_f \cdot \left(\frac{\Delta l}{l}\right)$

$\Delta R = R G_f \cdot \left(\frac{\Delta l}{l}\right)$

$\Delta R = R G_f \cdot \left(\frac{F}{A \cdot E}\right)$

$\Delta R = \left(\frac{R G_f}{AE}\right) \cdot F$

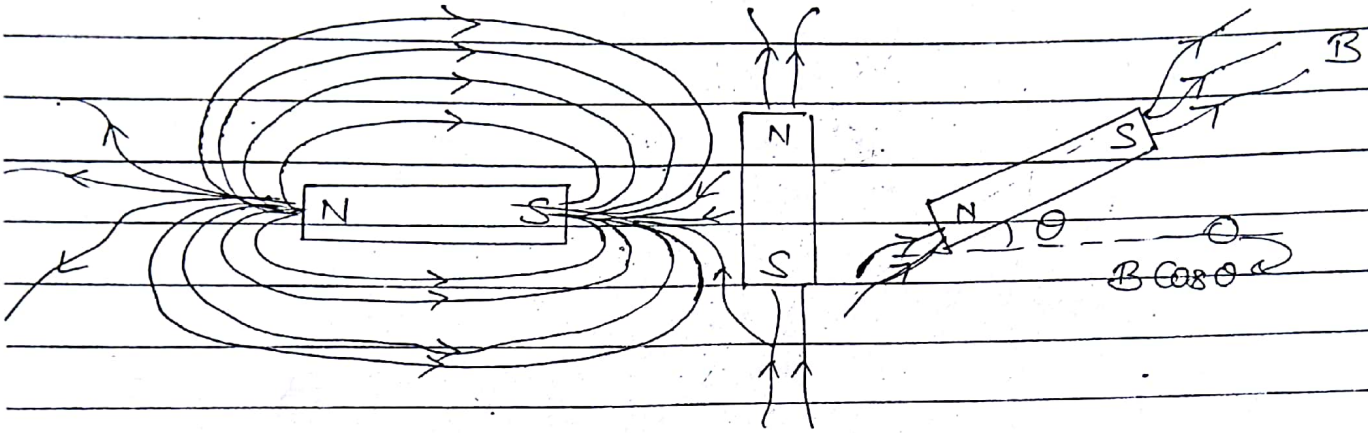
$\Rightarrow \boxed{\Delta R \propto F}$

↳ This relation is valid if the change in the area is very small

* Proximity Sensor :→ whether there is object or not.
  ↳ At the hand of Robots to detect object.
  ↳ Send & receives signals to µC.

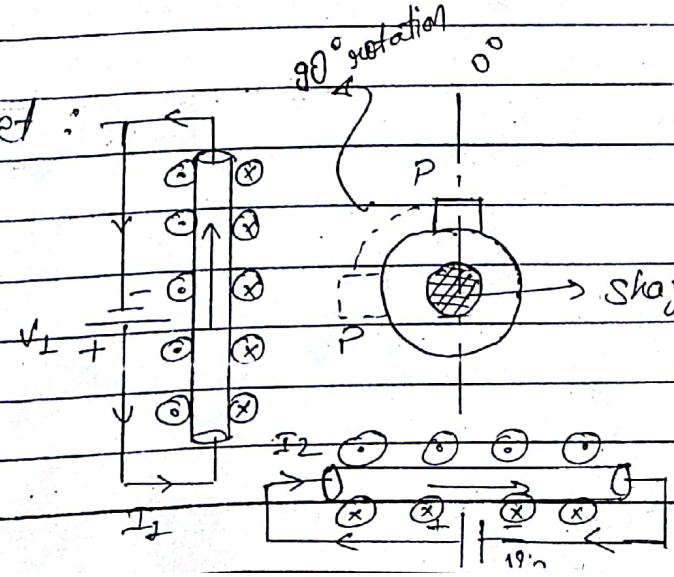
Basics of Magnetism :—

Magnet → Natural
Magnet → Electro - Magnet



Magnetic Flux ($\vec{\phi}$)
Magnetic field ($\vec{B}$)

Electro - Magnet :



Sensors :- which gives electrical energy as output.
Actuators :- " Mechanical

If I_1 & $I_2 = 0$ Amp ; B_1 & $B_2 = 0 \frac{wb}{m^2}$; $\theta = 0°$

$\Rightarrow$ If $I_1 \neq 0$ A ; $B_1 \neq 0 \frac{wb}{m^2}$
$I_2 = 0$ A ; $B_2 = 0 \cdot \frac{wb}{m^2}$
} $\theta = 90°$

$\Rightarrow$ If $I_2 \neq 0$ A ; $B_2 \neq 0 \frac{wb}{m^2}$
$I_1 = 0$ A ; $B_1 = 0 \cdot \frac{wb}{m^2}$
} $\theta = 180°$