Sensors Technology

Sensors

↳ **Defination:** A sensor is a device whic converts physical signals into electrical signals to be read/processed by a electrical system.

↳ **Actuators:**
- Perform an output function plus control external devices through conversion of energy into mechanical energy.
- They are specific type of transducer.
- They can switch voltage or currents.

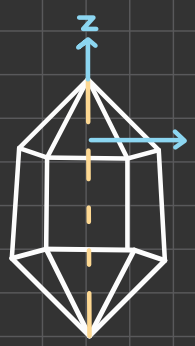
Ultrasonic Sensors

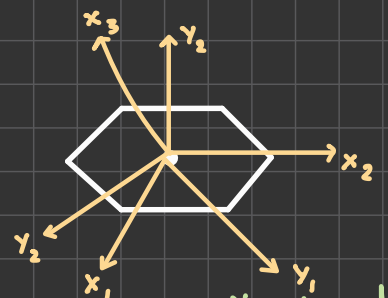
↳ **Piezoelectric Effect:**

- Piezoelectric Effect is the generation of electrical charge in response to a phyisical stress.
- This effect is reversible, meaning that the material exhibits both Direct Piezoelectric effect (Electricity production in response to stress) and Inverse Piezoelectric effect (stress production in response to electric field).
- Caused by a shifting of positive & negative charge centers in the material.
- Used in the field sound detection & production, electronic Frequency generation, high voltage production etc.

> Piezoelectric crystals :-

- When a voltage is applied to a quartz crystal along the electrical axix mechanical stress is produced in the Y axis.





- If Frequency of alternating voltage matches the natural frequency of the plate, Resonance is observed causing large oscillation amplitude.

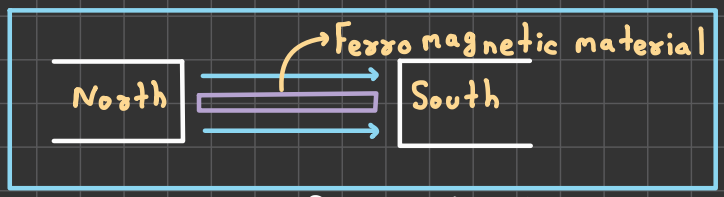
$$f = \frac{1}{2t}\sqrt{\frac{Y}{P}}$$

Frequency, Young's modulus, Density, thickness of crystal

> Piezoelectric Motors :-

- In piezoelectric motor, an electric pulse is recieved and is converted to directional force to move a ceramic plate.
- Piezoelectric element creats motion by moving against a static Plat form.

↳ Magnetostriction Effect:



Process of magnetization

- Magnetrostrictive materials change shape when subjected to a magnetic field.
- This change in shape is caused due to rotation of small magnetic parts in the materials.
- Saturation is achieved when all domains of the material are alinged.
- Negative magnetostriction materials contract with increased magnetic field and vice versa
- Positive magnetostriction materials expand with increased magnetic field and vice versa.

$h = \frac{\Delta L}{L}$ → Change in length; L → Original length

↳ Magnetostriction coefficient

$F = \frac{1}{2L} \times \sqrt{\frac{Y}{P}}$ (Frequency → F; Y → Young's modulus; P → Density; L → length of rod)

> Magnetostriction Transducers :-

- Its a device that converts mechanical energy into magnetic energy and vice versa
- It has high bi-directional coupling between mechani and magnetic states hence can be used as a sensor and a actuator.
- Does not require current passage in wire to produce/ measure magnetic field.