~~Transucer~~ .

Transducer

Process of converting one from of energy into another is called transduction. and device that performs this function called transducer

⇒ The devices which converts other from of energy into electrical from are electrical transducer

Advantage

- Very small power lvl.
- Effects of friction are minimized.
- output easily used, stored, processed.

based of electrical circuit parameter

Classification of transducers

- Resistance - capacitance - inductance - voltage & current.

↳ of a resistor element — Strain ঘটাবে

$$\hookrightarrow R = \frac{\rho L}{A}$$

ফিরাও

Strain Gauge.

Resistance Strain gauges are also known as piezo resistive gauges.

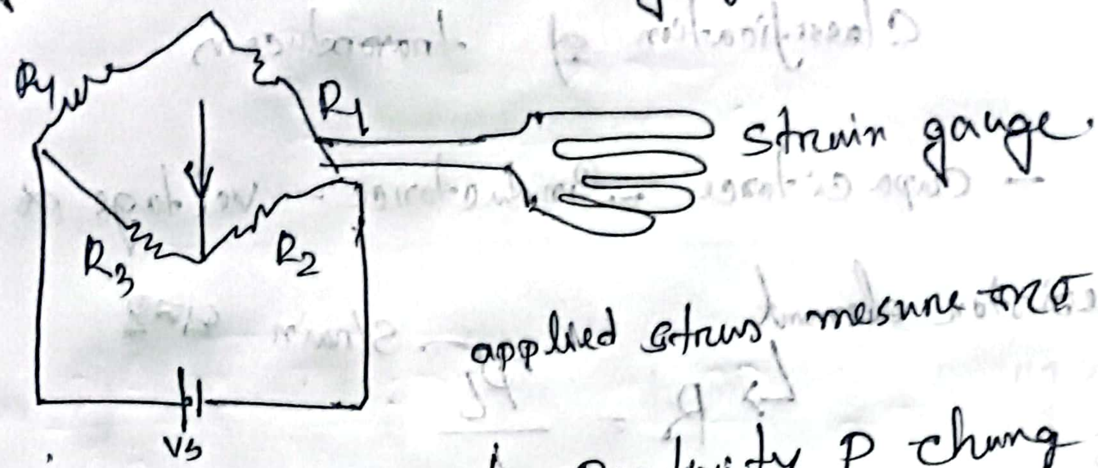
- unit of strain is micro. strain.

↳ 1 Micro strain = $1 \mu m/m$

Piezo electric effect: It is a the change in electric polarization of the material when there is the application of mechanical pressure.

Strain আসলে Change in Resistance

Bridge circuit of strain gauge.



applied stress measure করে

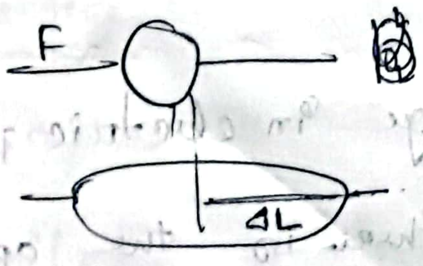
resistance.

$$R = \frac{\rho L \text{ - lenght}}{A \text{ - area}}$$

- Resistivity ρ change হয়
- অথবা dimension এর ও change.
- Peizo Resistive effect

Strain Gauge factor $= Gf = 1 + 2f$.

Theory of strain Gauge:



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

$$\text{Stress} = \frac{F}{A}$$

$$\text{Strain} = \frac{\text{change in dimension}}{\text{original}}$$

$$= \frac{\Delta L}{L}$$

CZ A,L দুইটাই strain হয় এইগুলো হয়

$$= \frac{\Delta A}{A}$$

- Force দিয়ে যে পরিবর্তন Longitudinal strain. $\frac{\Delta L}{L}$
- Area " " " Lateral " $\frac{\Delta A}{A}$

উভয়দিকে differential.

$$R = \frac{PL}{A}$$

যেখানে P constant. L, A const. ...

P A " "

L "

L, A, P তিনটাই উভয় দিকে

$$\frac{dR}{ds} = \frac{d}{ds}\left(\frac{PL}{A}\right)$$

$$\frac{dR}{ds} = \frac{P}{A}\left(\frac{dL}{ds}\right) - \frac{PL}{A^2}\frac{dA}{ds} + \frac{L}{A}\frac{dP}{ds}$$

$$\frac{d}{ds}\frac{1}{A}$$

$$\frac{d}{ds}A^{-1}$$

$$\to -1\,A^{-1-1}$$

$$\to -A^{-2} = -\frac{1}{A^2}$$

$$\frac{1}{R}\frac{dR}{ds} = \frac{P}{AR}\frac{dL}{ds} - \frac{PL}{A^2R}\frac{dA}{ds} + \frac{L}{AR}\frac{dP}{ds}$$ [R দিয়ে ভাগ করে]

$$\frac{1}{R}\frac{dR}{ds} = \frac{P}{A\cdot\frac{PL}{A}}\frac{dL}{ds} - \frac{PL}{A\cdot A\cdot\frac{PL}{A}}\cdot\frac{dA}{ds} + \frac{L}{A\cdot\frac{PL}{A}}\cdot\frac{dP}{ds}$$ [$R = \frac{PL}{A}$ put]

$$\therefore \frac{1}{R}\cdot\frac{dR}{ds} = \frac{1}{L}\cdot\frac{dL}{ds} - \frac{1}{A}\cdot\frac{dA}{ds} + \frac{1}{P}\cdot\frac{dP}{ds} \quad \text{— (ii)}$$

we know $A = \pi r^2$, আবার $r = \frac{D}{2}$

$$= \pi \left(\frac{D}{2}\right)^2 = \frac{\pi D^2}{4}.$$

A এর differential

$$\frac{dA}{ds} = \frac{\pi}{4} \cdot D^2 = \frac{\pi}{4} 2D \frac{dD}{ds} \quad \text{--- (i)}$$

(i) মান (ii) নং বসাই $\left(\frac{dA}{ds}\right)$ মান

$$\frac{DR}{Ds} = \frac{1}{L}\frac{dL}{ds} - \frac{1}{\frac{\pi D^2}{4}} \times \frac{\pi}{4} \cdot 2D \frac{dD}{ds} + \frac{1}{P} \cdot \frac{dP}{ds}$$

A মান

$$= \frac{1}{L}\frac{dL}{ds} - \frac{2}{D}\frac{dD}{ds} + \frac{1}{P}\frac{dP}{ds} \quad \text{(iii)}$$

Poission Ratio = $- \dfrac{\text{Lateral strain}}{\text{Longitudinal Strain}}$

$$V = - \frac{\frac{dA}{A} / \frac{dD}{D}}{\frac{dL}{dL}}$$

D দিয়েছে Area এর Dimention Same

$$\therefore \frac{dD}{dD} = -V \frac{dL}{dL} \quad \text{--- (iv)}$$

(iv) মান (iii) বসাই

$\frac{dD}{D}$ এর মান বসাই

$$\frac{1}{R}\cdot\frac{dR}{ds} = \frac{1}{L}\frac{dL}{ds} + \frac{2v}{L}\frac{dL}{ds} + \frac{1}{P}\frac{dP}{ds} \quad -v$$

$$\frac{1}{R}\frac{dR}{ds} = \frac{1}{L}\frac{dL}{ds}\left[1 + 2v\right] + \frac{1}{P}\frac{dP}{ds} \quad -(v)$$

Gauge factor : output বাড়ে আসছে with respect to input.

$$G_f = \frac{\Delta R / R}{\Delta L / L} \qquad \frac{\text{change in resistance}}{\text{Change in Length}} \text{ are } G_f.$$

$$\therefore \frac{\Delta R}{R} = G_f \cdot \frac{\Delta L}{L}$$

যদি small chang হয় ds বাদ যাবে না (dR কে ∆R লিখবো)

(v) থেকে·

$$\frac{\Delta R}{R} = \frac{\Delta L}{L} + 2v\frac{\Delta L}{L} + \frac{\Delta P}{P}.$$

G_f হবে

$$\frac{\Delta R / R}{\Delta L / L} = \frac{\Delta L/L}{\Delta L/L} + 2v\frac{\Delta L / L}{\Delta L / L} + \frac{\Delta P/P}{\Delta L/L}. \quad \left[\frac{\Delta L}{L} \text{ দিয়ে ভাগ}\right]$$

$$G_f = 1 + 2\nu + \frac{\Delta\rho/\rho}{\Delta L/L}$$

$$= 1 + 2\nu + \frac{\Delta\rho/\rho}{\epsilon}$$

এখানে (ν)

ধরি

ϵ = strain

$= \Delta L/L$

অনেক small হয়

তাই এটা

Piezoelectic effect negligible

$$\Rightarrow G_f \doteq \boxed{1 + 2\nu}$$

(প্রমাণিত) Proved

Application of PV / Solar cell.

- A solar cell also known as PV cell.
- It is an electrical device that converts light energy into electrical energy through the photovoltaic effect.
- Solar cell is P-N junction diode.
- Solar cell produce open circuit voltage 0.5 - 0.6 volts.
- Individual solar cells can be combined to form modules commonly known as solar panels.

working principle of solar cell.

- when light reaches the p-n junction, light photons can easily enter the junction through thin n-type layer.
- The light energy, in the form of photons, supplies sufficient energy to the junction to create number of electron-hole pairs.

- The free electron in the depletion can quickly come to n type side.

- The holes in the depletion can quickly come to the P-type side.

- In processing Photo-voltage set up.

- If we connect a small load across the junction, there will be tiny current folowing.

materials used in Solar cell.

- Silicon · GaAs · CdTe · CuInSe$_2$.

Advantage Solar cell	Disadvantage solar cell.
· No pollution associated	· high cost installation.
· It must for a long time	· Low efficiency.
· No Maintenance cost	· Cloudy day its dont work.

Application of opto-electronic.

Transducer

- opto electronics ⇒ It deals with application of electronics devices that interact with light:

opto → optical → light

electronics → electronic → semi-conductor

[Means this device detect light and transfer light signal to electrical signals] ← Like transducers.

Types of optoelectronics

- photodiode
- solar cells
- Light Emitting Diodes
- optical fiber
- laser diode.

Photo diode: Convert light (proton) energy to electrical energy (current).

- contain active P-n junction, operated reverse bias.
- when a poton with plenty of energy (P.D.) strikes in semiconductor, an hole pair is created.

• This electric field across the depletion zone is equal to a negative voltage.

• This method called inner photoelectric effect.

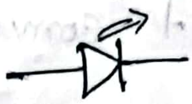
: Its can be used 3 modes: photovoltaic as. a solar cell, forward biased as an led, reverse biased as a photo detector.

. photo diodes used [camaras, medical, communication devices

photo diode এর forward bias এ connect করা হয় then Ammeter কোনো current এর change detect করতে পারে না, তাই reverse bais use হয়।

Solar Cell : A solar cell or photo voltaic cell is an electronic device that directly converts sun's energy into electricity.

Light Emitting diodes: It is a diode works on forward bais condition



, when a voltage is applied to the leads of the LED, the electrons recombine with the holes within device. release energy from photons.

optical fiver: It is a plastic and made for glass.

- Sometimes its thin than human hair
- Its includ 3 layer → a core, a cladding and a jacket.

light transmitting region

different colours.

protective layer.

- orange clr cable ⇒ single mode fiber.
- yellow " " ⇒ multimode fiber.

Leasen Diodes

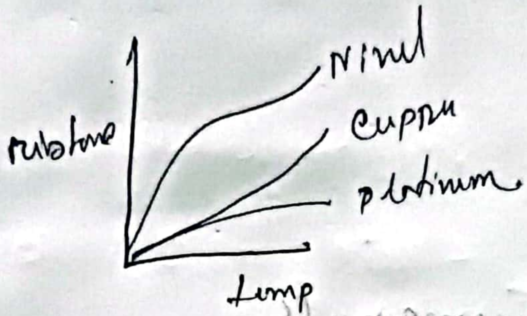
A leasone diodes is convent electrical energy into light energy Live Infrared diodes LeDs

LED principle / Application

- LeD based Automatic emergency light
- Mains operated LED light.
- Display of Dailed telephone on 7 Seg Display
- sOlon powered Led Light Auto Intensity control

Resistance temp detector (RTD)

RTD works on the principle that the electric resistance of a metal changes due to change in its temp.



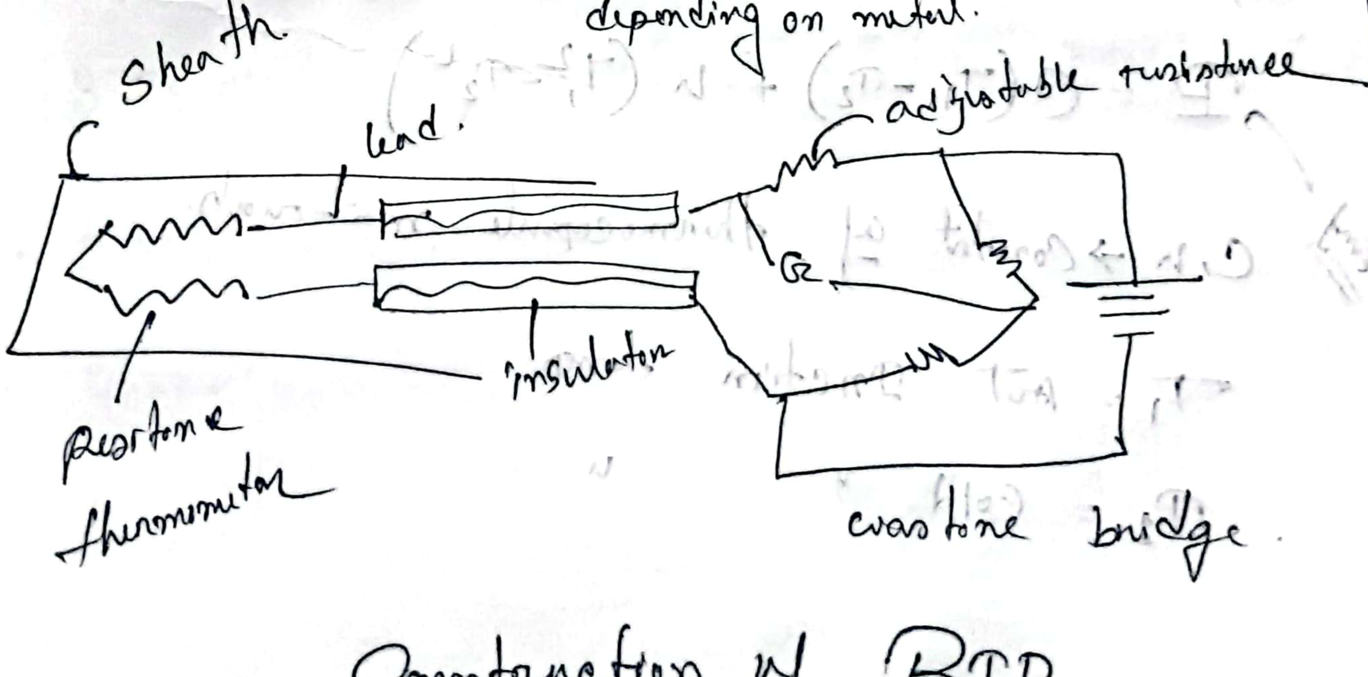
The co-relation of RTD is

$$R(T) = R_0 \left[1 + A(T - T_0) + B(T - T_0)^2 \right]$$

resistance of Temp

reference temp

depending on metal.



Construction of RTD

Application : RTD

- food processing
- Textile, plastic Industry.
- Petrochemical. "
- Air conditioning.

Thermocouple

- It is a sensor use to measure the temp. Voltage difference নির্ধারণ করা হয়, যেটি voltmeter দেখা যায়।

$$E = C(T_1 - T_2) + K(T_1^2 - T_2^2)$$

emf

$C, K \rightarrow$ Constant of thermocouple materials.

T_1 = Hot Junction temp

T_2 = Cold " "

Math:

During experiments with copper constants thermo-couple it was found that $C = 3.75 \times 10^{2}$ mv/°C and $K = 4.5 \times 10^{-5}$ MV/°C² If $T_1 = 100°C$ and the cold junction T_2 is kept in ice. compute Emf.

Ans

We know

$$E = C(T_1 - T_2) + K(T_1^2 - T_2^2)$$

$$= 3.75 \times 10^{-2} \frac{mv}{\cancel{°C}} (100\cancel{°C} - 0°C) + 4.5 \times 10^{-5} \frac{mv}{\cancel{°C^2}} \left[(100°C)^2 - (0°C)^2 \right]$$

here
$C = 3.75 \times 10^{-2}$ MV/°C
$K = 4.5 \times 10^{-5}$ MV/°C²
$T_1 = 100°C$
$T_2 = 0°C$ (ice kept)

$$= (3.75 \times 10^{-2} \times 100) \text{ mv} + (4.5 \times 10^{-5} \times (100)^2) \text{ MV}$$

$$= 3.75 \text{ mv} + 0.45 \text{ mv}$$

$$= 4.10 \text{ MV}.$$

Diffrence

RTD	Thermocouple
• It is more suited to measure the lower temp range.	• It is suited to measure the larger temp range
• The measuring range is -200°c to 500°c	• The measuring range is -180°c to 2320°c
• Good stability	• poor stability.
• good accuracy	• poor Accuracy.
• More expensiv than thermocopulle	• Cheaper than RTD.
• O/P chang in Resistance	• o/p change in voltage.