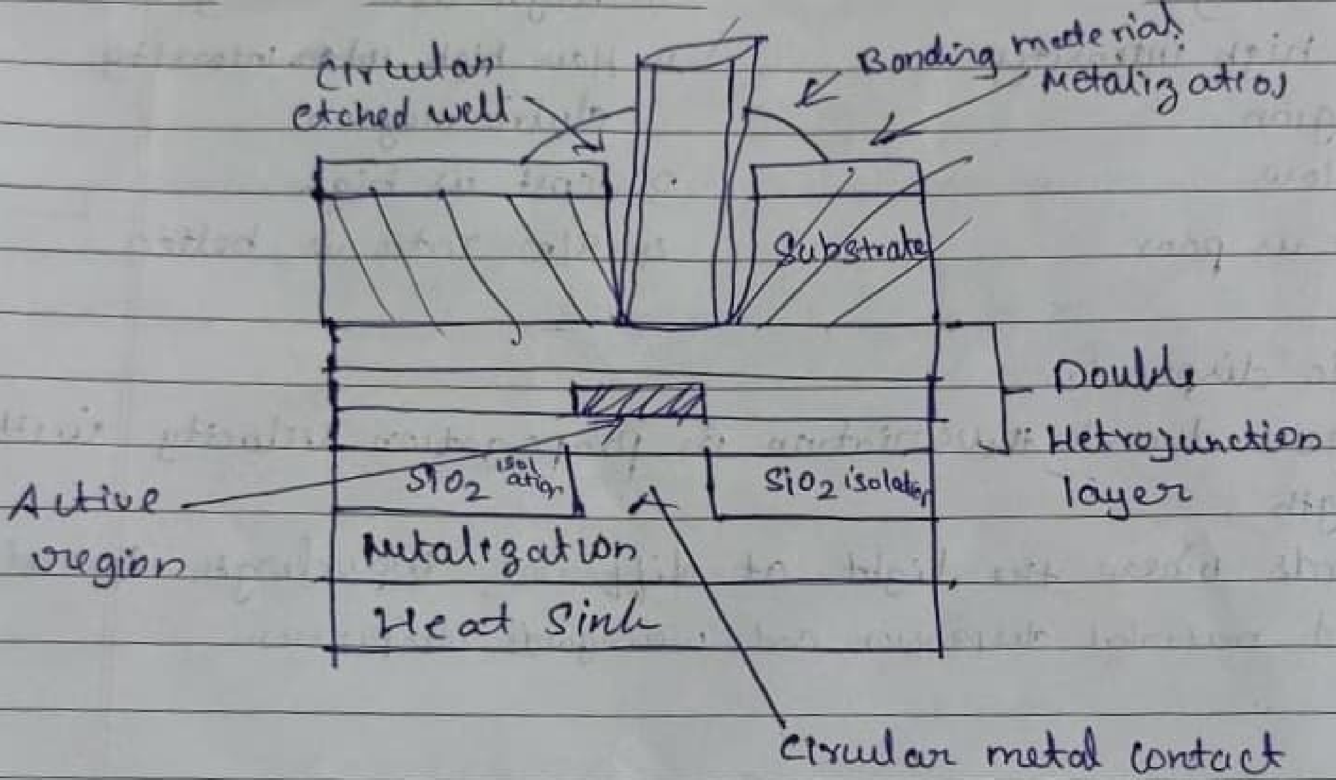
① ~~Structure~~ Surface emitting LED and edge emitting LED

Surface emitting LED

CHANNY



(b) → It is a modified di-heterojunction LED
→ The Surface emitting LED consists of thin layer ~~of~~ in center which is active p-type GaAs:

→ on top side the central layer is bounded by n-type ~~AlG~~ AlGaAs/$n^+$- type GaAs ~~on top side~~.

→ on bottom side the central layer is bounded by P-type AlGaAs/$p^+$- type GaAs.

→ The extreme top $n^+$ type GaAs and extreme bottom $p^+$ type GaAs are used to provied low ohmic contact.

→ The di ~~heterojunction~~ optical fiber is butt coupled with itself

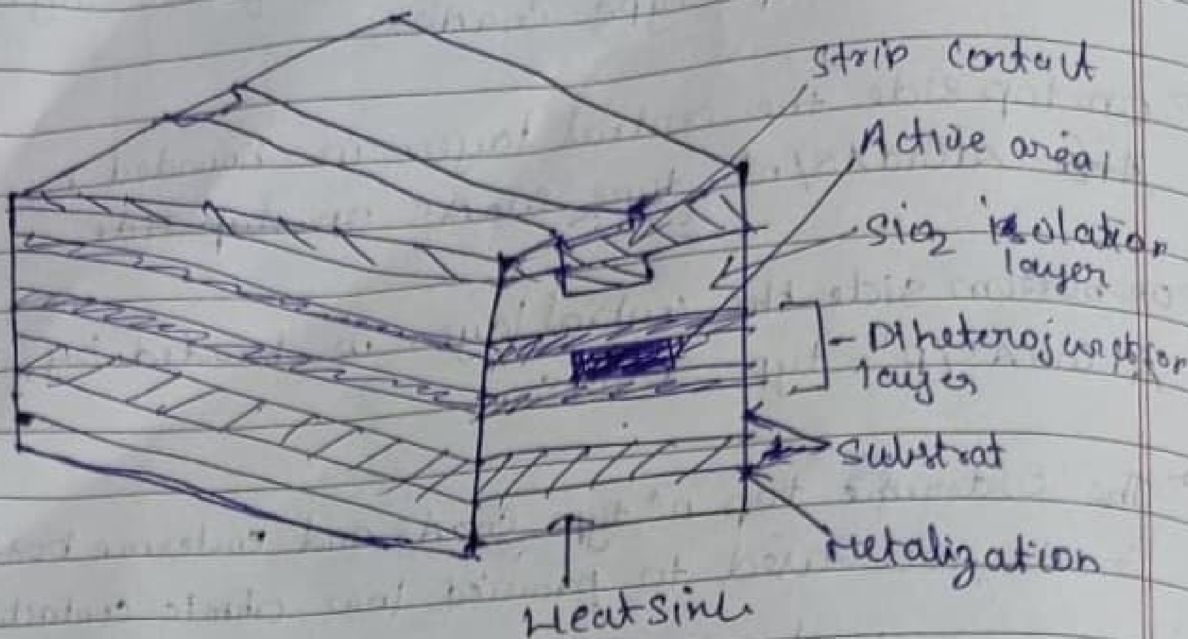
→ when the refractive index of both p-type and n-type are same the light can come out of all direction ~~of~~ semiconductor, However the active layer near the surface emitt the max amount of light while absorbing from the other parts.

Advantage :
→ used for long wavelength applications
→ Optical loss is very low.
→ High optical coupling efficiency

CHANNY

Disadvantage:
1. It transmitt data 20Mbps less than edge emitting LED.
2. Short optical link with large NA.

# Edge-emitting LED




-> It is widely used in optical ~~fiber~~ fiber communication System
-> It is used for long wavelength communciation like 1.33 to 1.55 μm.
-> Modern epitaxial tech such as MBE, MOCVD etc. are used to design
-> Centeral layer is made using InGaAS with narrow bandgap
-> It bounded with wide narrow bandgap layers. Such as ..
p+ InGaAS and n+ InGaAS layers
-> These two layer help injected electrons and holes into center layer.

Advantages:
1. It offers >20mbps data speed than surfrace emitting LED. (SELED)
2. It gives high efficiency with low radiance
3. It radiates less power to air than SELED

Disadvantage:
1. Difficult to design heat sink
2. Its expensive
3. Structure is complex.

CHANNY

FOOE

Part - C

1,4,7,8 → unit - 2
2,3,5,6 → unit - 3

1) Signal Attenuation:

→ Signal Attenuation is a main important properties of optical fiber, because it determines the max unamplified or repeatless seperated between a transmitter and a reciever

→ The attenuation of light signal propragating along with fiber is also consider in design of optical fiber communication

→ The degree of attenuation determines the max transmission distance b/w transmitter and receiver.

→ The basic attenuation mechanism in fiber are:

1. Absorption
2. Scattering loss
3. repeative loss of optical energy

CHANNY

→ when light travels along with fiber the power decreases exponentially with distance

→ If P(0) is the power at orgin, with P(z) Power at destination with distance z is

$$P(0) = P(z)\, e^{-a_p z}$$

where

$$a_p = \frac{1}{z} \ln \left[ \frac{P(0)}{P(z)} \right]$$

is the ~~fiber optic optic~~ fiber attenuation coefficient given in units of $km^{-1}$

Read this (~~without~~ striked by mistake)

Absorption:

→ Absorption are caused by 3 diff mechanism:

1. Absorption by atomic defects in glass ~~com~~

2. Extrinsic absorption by impurity of atoms in glass

3. intrinsic absorption by basic constitued atom in fiber material.

→ Absorption by atomic defects are caused by imperfection in structure

→ Examples are high density clustring of atomic groups, Oxygen defect in Structure, missing molecules

→ Attuention loss caused by atomic defect is negeliable when compared to intrinstic and impurity attuention.

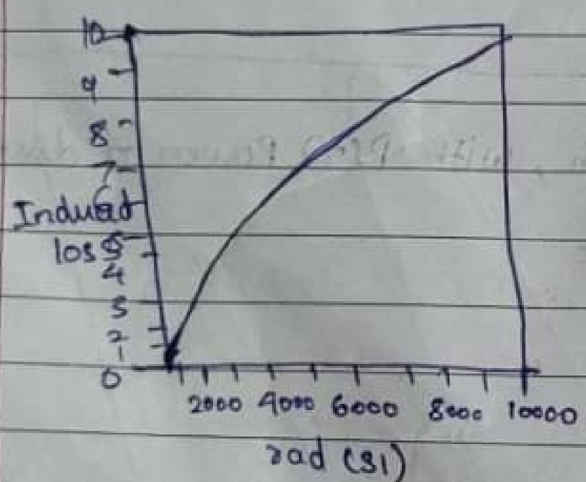
→ Radation damages the material by changing its internal structure

→ The damage caused by material to radiation is measured by energy of the ray, radation stam (Dose rate), Fluence

→ rad(Si), the amount of radiation absorbed in bulk silicon

→ unit is defined as rad(Si) ⇒ 100 erg/g ⇒ 0.01 J/kg

→ Higher the radation larger the attenuation




CHANNY

7. Scattering losses and Bending losses with (dia, expression)

## Scattering losses:

→ Scattering loss occurs from microscopic variation in the material density, compositional fluctuations, structural inhomogeneities

→ ~~As glass~~

→ As glass is compressed of randomly connected molecules where the density of molecules is higher (or) lower than the average

→ The glass is made up of several oxides $SiO_2$, $P_2O_5$, so compositional fluctuation can occur

→ These two effect gives rise to refractive index variation

→ These index cause raylight type scattering of light.

$$\Rightarrow \alpha_{scat} = \frac{8\pi^3}{3\lambda^4}(n^2-1)^2 k_B T_f \beta_T$$

$k_B$ → Boltzman constant

$T_f$ → isothermal compressibility,

$\beta_T$ → Temperature where the density fluctuation are frozen

unit → nepers/km.

CHANNY

## Bending loss:

→ Bending loss occurs whenever the optical fiber undergoes a bend in finite radius of curvature

→ Fiber is subjective to ~~to~~ 2 types of bend

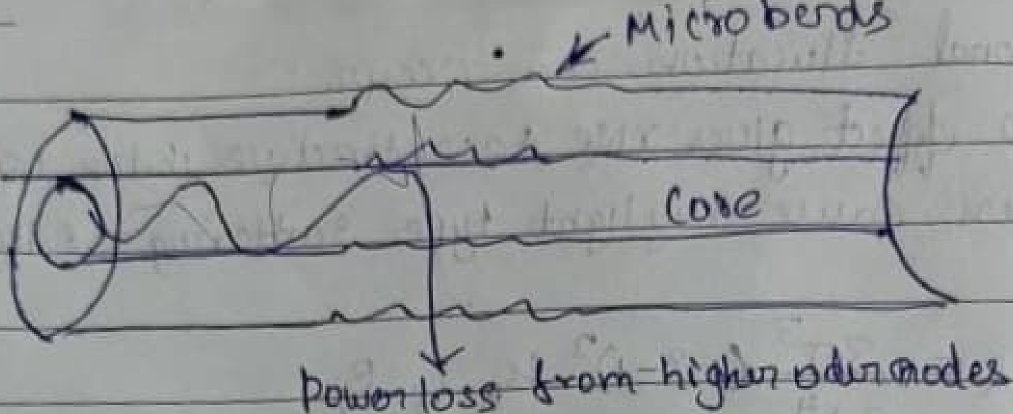
1. Macroscopic → the radii is greature the fiber diameter
2. Microscopic → when the ~~fi~~ fiber is incooporated into cables

→ For slight bend the excess loss is very small

→ As the radius of curvature decrease, the loss increases exponentially

→ If the bend is made small, once it reached its threshold the losses suddenly becomes high.

CHANNY




→ Effective number of modes, $M_{eff}$

$$M_{eff} = M_{\infty}\left\{1 - \frac{a+2\alpha}{2a\Delta}\left[\frac{2a}{R} + \left[\frac{3}{2n_2 kR}\right]^{2/3}\right]\right\}$$

$n_2$ is cladding refractive index

$k = 2\pi/\lambda$ wave propagation index

$M_{\infty}$ is the total no of mode in straigh fiber. $\Rightarrow \frac{a}{a+2}(a k n_1)^2$