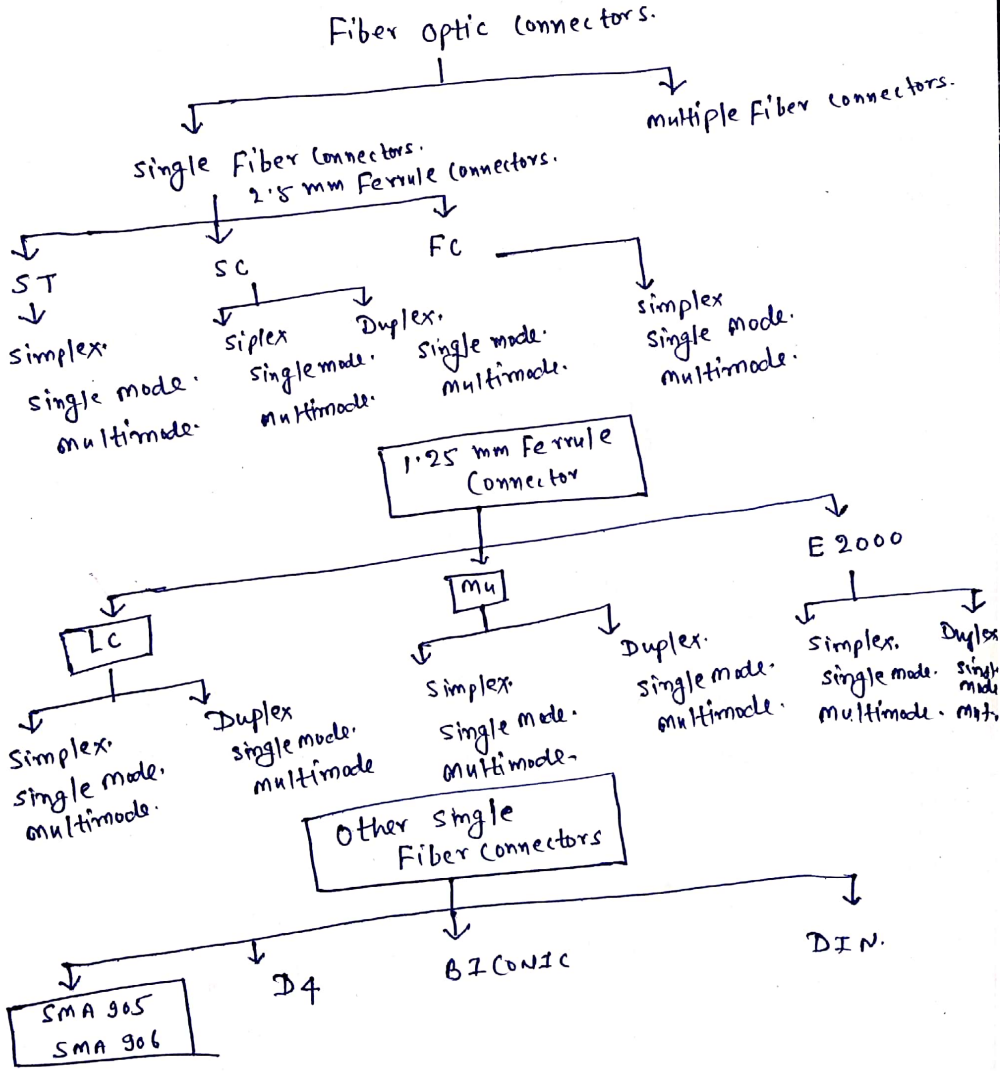
Sub – optical Fiber Comm. Elex. III rd year. Semester – 6th.

Basics of optical Fiber Connectors.

* Connectors are used to join optical sources as well as detectors with optical Fiber.
* The main criterial about the connectors is that the Connectors should be aligned properly in order to reduce losses.



* - Fiber optic splicing → Joining two optical Fibers togather.

Two types of splicing techniques are -

→ Mechanical splicing :— . Just a mechanical alignment device.

→ Holds the two fiber ends in a precisely aligned position

→ still two separate Fibers, not continuous.

* Fusion splicing :— → Two fiber ends are aligned and then fused or welded together.

→ Using heat or electric arc.

→ Two Fibers become continuous.

Losses in optical fiber —
① Absorbtion losses.
② Scattering losses.
③ Dispersion losses.
④ Bending losses.

→ What is attenuation (α) = $\frac{10}{L} \log_{10} \left(\frac{P_{in}}{P_{out}}\right)$.

* Characteristics of light used in optical comm. →.

→ Light source should be highly directional, to make the launching of light into an optical Fiber.

→ It should emit light at wavelength, where the optical fiber has low losses and low dispersion. the detectors should be efficient at that wave length.

→ It is also required, that the optical source must couple enough optical power to overcome losses in fiber

and in the connectors, and after these losses enough power should be left to derive the detector.

→ The optical sources should be linear to minimise the distortion and noise.

→ To minimize the dispersion in the fiber the optical source should have a very narrow spectral bandwidth.

→ The light source must be inexpensiv and also very reliable.

Comparision of optical source LED and LASER.

parameters.	LED	LASER
efficiency.	Low	high.
Response time.	slow	fast.
Data rater	Low	high.
spectrum.	Broad	narrow.
Beam nature.	Non - coherent	coherent light beam.
power	low	high.
Distortion.	high	low.
Distance.	high.	Less.
heating problem.	short dis.	long distance.

 Sub - optical Fiber Comm. IIIrd year Elex- semen- 6th.

Photo detectors in optical Fiber - Photo detector is used to convert light source into electrical signal.

For this we use - (i) PIN Diode
(ii) Avalanche Photo Diode.

* PIN Diode :-

Basics of PIN Diode — As name indicates. this diode has intrinsic layer sandwitched in between highly doped P-type and N-type layer.

→ It gives performance improvment Compared to Pn Photo diode.

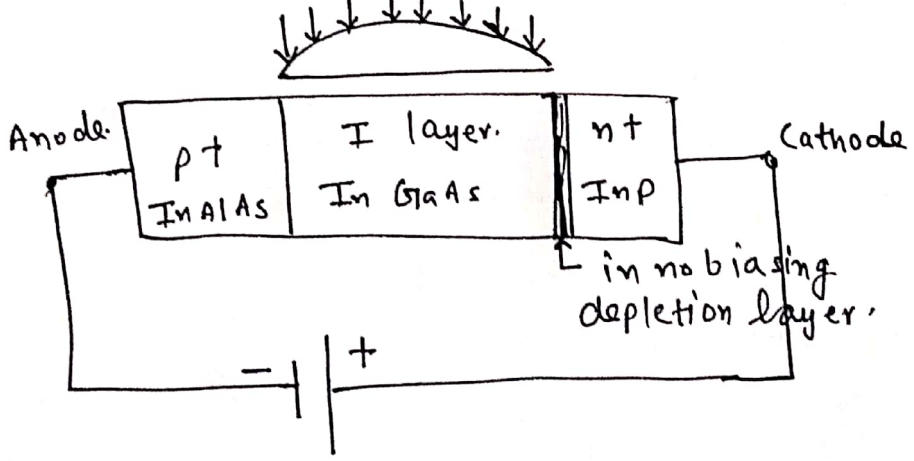
→ PIN Photo diode has layer as p+_i_n+

→ p+ and n+ layer has less resistivity around 1Ω.

→ I layer has high resistivity ranges from 10 KΩ/cm to 100 KΩ/cm.

→ PIN Diode has larger depletion layer.

* Structure of PIN Photo diode —



PIN Diode used reverse bias.

$C = \varepsilon_0 \varepsilon_r \frac{A}{d}$ ← d is more

C is less.

Advantages — very low RB necessary.
— high quantum efficiency.
— A large bandwidth can be obtained.
— Lower noise performance.

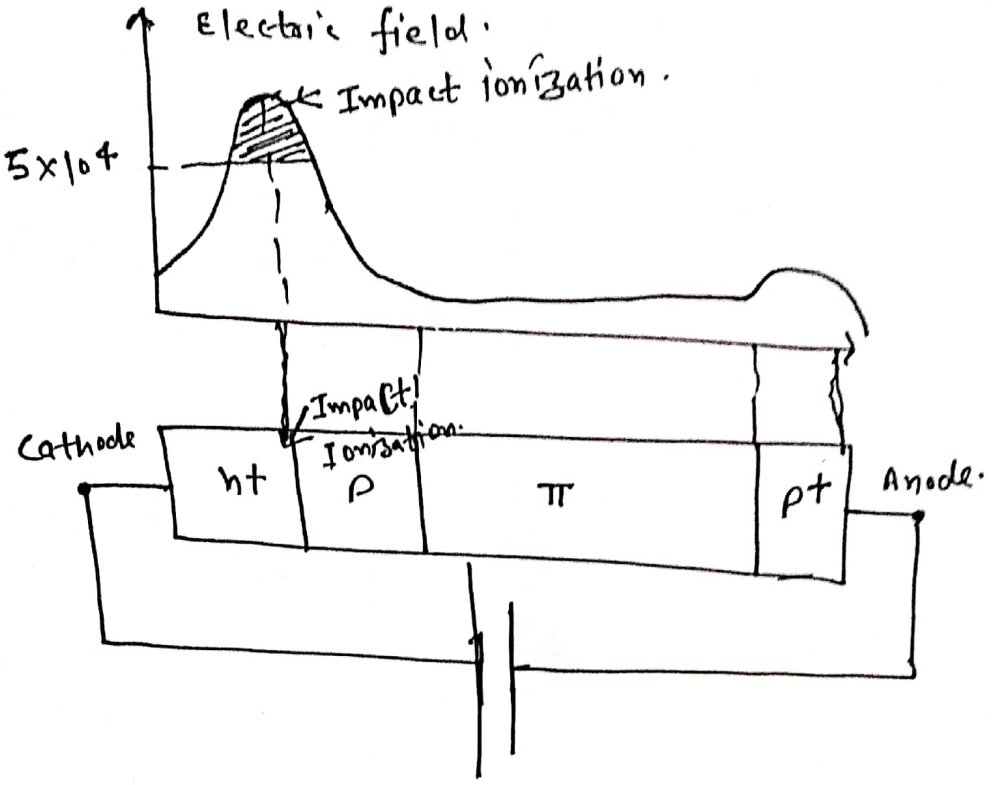
Disad. — It does not amplify signal.

⟶ Avalanche photo diode (APD)

→ In case of conventional photodiodes and PIN photodiodes o/p current is very small (100 μA)
→ This is because, these photodiode gain is less than 1.
→ To obtain high current and high gain APD is used.

→ operation of APD — Here Reverse bias is applied nearer to breakdown voltage.
⟶ incident light will produces electron hole pair.
→ These carriers will travel with their saturation velocity.
→ As velocity is maximum, these carriers will collide with other atoms.
→ so new electron hole pairs are generated.
→ These new carries also travel along with initial carriers.
→ Those increase in carrier will increase current
→ This process of generating more number of carrier is called an impact ionization.

Structure of avalanch photo diode : —
→ silicon material gives 90% of efficiency.
→ APD has layers as per $p^+ - \pi - p - n^+$
→ Here P layer is having very high resistivity
→ So all the reverse bias is mostly applied across PN+ region.
→ If reverse bias is increased than depletion layer also increase.



Advantage :— * at P-nt region impact ionization taken place.

* Electric field req. to do impact ionization is from 10⁴ to 10⁵ v/m.

— This will increase photo current.

— that 200 gain could be obtained.

Adv. — High gain

Disadv. — * high operating voltage is required

* At high voltage noise is high.

* Avalanche means output is not linear.

* LED used in optical source.

(I) Homojunction LED. (II) Hetrojunction LED.

Homojunction LED.

* If a pn junction is made from two mixture of same types of atoms, then it is called an homojunction.
* layers have similar semiconductor material, but doping is diff.
* Homojunction LED is also called Surface emitting LED.

Advantage – it has low terminal impedance.

Disadvantage – Emitted light is non directional.

Hetrojunction LED.

* In a pn junction if made from two dissimilar layers of atoms, than it is called Hetrojunction.
* Layers of semiconductor are having diff. band gapes
* Hetrojunction LED is also called a edge emitting LED.

Adv. due to increased current density fine light spot is obtained.

– high data rate.

Types — (I) Planar LED
(II) Surface Emitting LED.
(III) Edge emitting LED.

→ LASER (Light amplification by stimulated emission of radiation)

→ line width of light by Laser is very narrow.
→ mono chromatic. (single freq. and wavelength.
→ High directivity.
→ High intensity of beam.
→ high quantum efficiency.
→ Can travel very long dis.
→