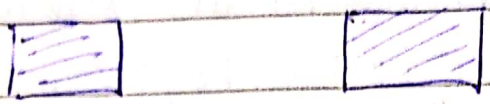
Data Communications
Notes

Guided Transmission Medium:



Transmitter Receiver

$$C = 2B \log_2 M$$ → No. of Levels.

↳ Capacity limit based on the bandwidth.

$$C = B \log_2 (1 + S/N)$$

↳ Based on Signal-to-noise Ratio.

Transmission Medium

Guided (Solid Medium)
Ex:
i) Copper twisted pair
ii) Copper co-axial Cable
iii) Optical Fiber

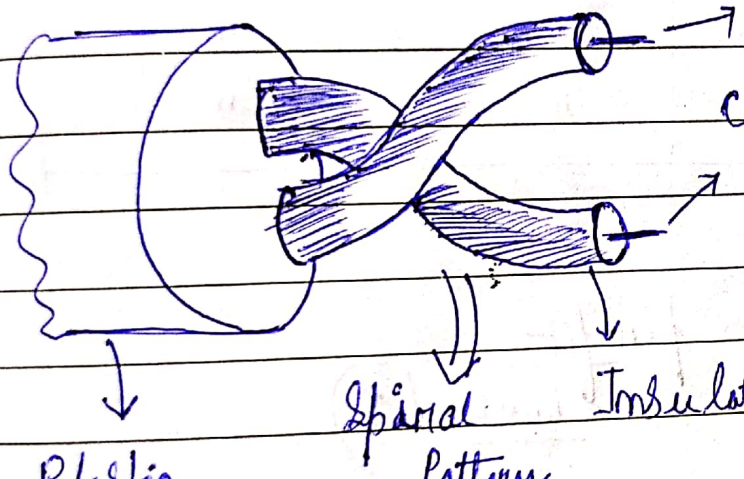
Unguided → Do not guided.
(Air)
↑ Electro-magnetic Signals
i) Wireless transmission.

Notes

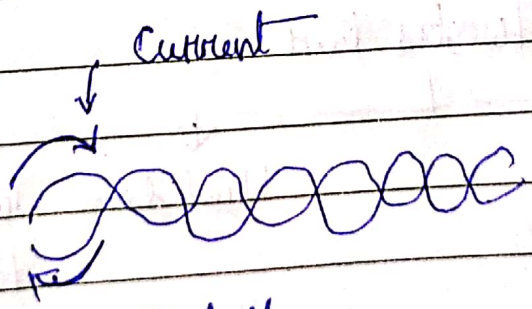
Quality of transmission:

In case of the guided Medium the Quality of the transmission Mainly depends on the Medium. On the other hand for unguided Media the bandwidth of the signal produced by transmission antena is more important.

COPPER Twisted PAIR:



Why twisting:



Field induce by one will be opposite to the other one

i) Decrease Cross talk
ii) No. of twist per length (-twist)

↑ => More performance

↑ => Cost increases.

Twisted Pair Categories :→

Categories	B/W	Data Rate	Digital/Analog	Use
Cat 1	Very low	< 100 Kbps	A	Telephone
Cat 2	< 2MHz	2Mbps	A/D	T-1 Lines
Cat 3	16MHz	10Mbps	D	LANS
Cat 4	20MHz	20Mbps	D	"
Cat 5	100MHz	100Mbps	"	"
Cat 6				
Cat 7				

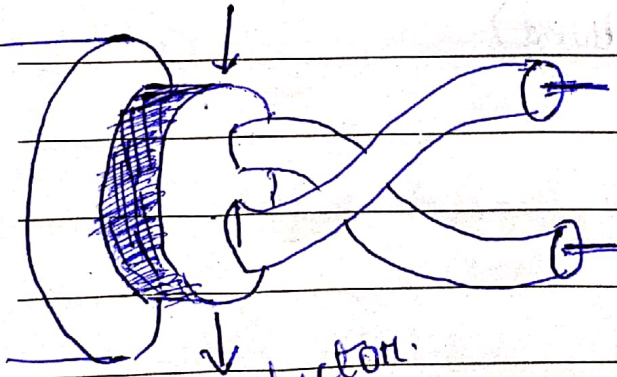
Cat 6 : 3-4 twists per ft

Cat 5 : 3-4 " " inch (↑)

Twisted Pair

Shielded Twisted Pair (STP)

Metal Shield.



Conductor.

↳ Braided Mesh

Unshielded Twisted Pair (UTP)

i) No protected Shield

ii) Ordinary Telephone wire

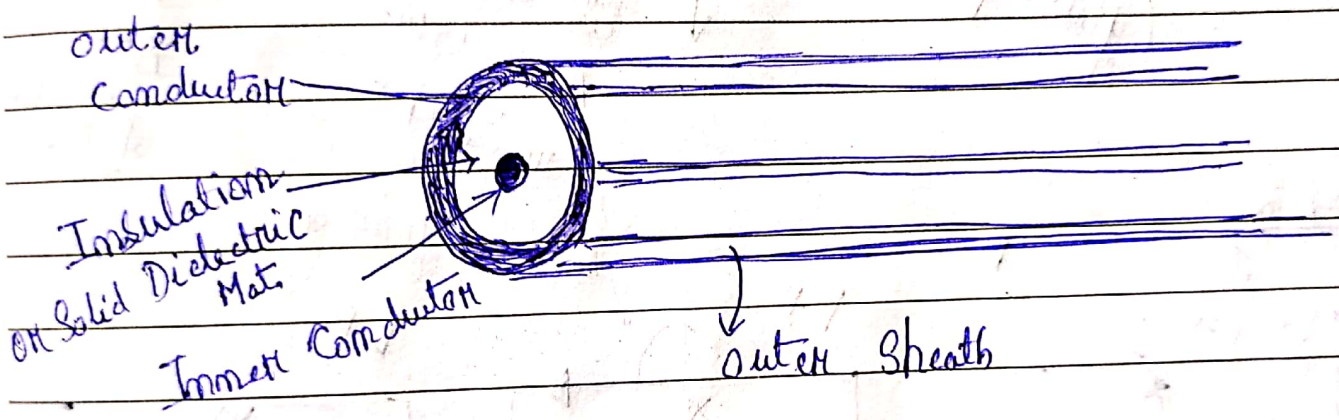
iii) Subjected to external electro-magnatic interference

Notes

UTP: Applications:

i) Local loop in telephone lines
ii) Digital Subscriber Lines (DSL)
iii) LAN (10 BaseT, 100 BaseT)
iv) Connector – RJ45 (8 lines)

COAXIAL CABLE: (C.C.)



i) Due to the Shilding C.C. are much less Susceptible to interference or crosstalk than the Twisted pair.

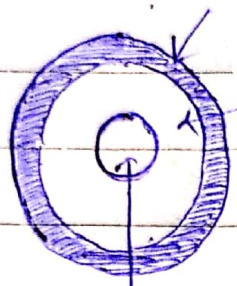
Applications:

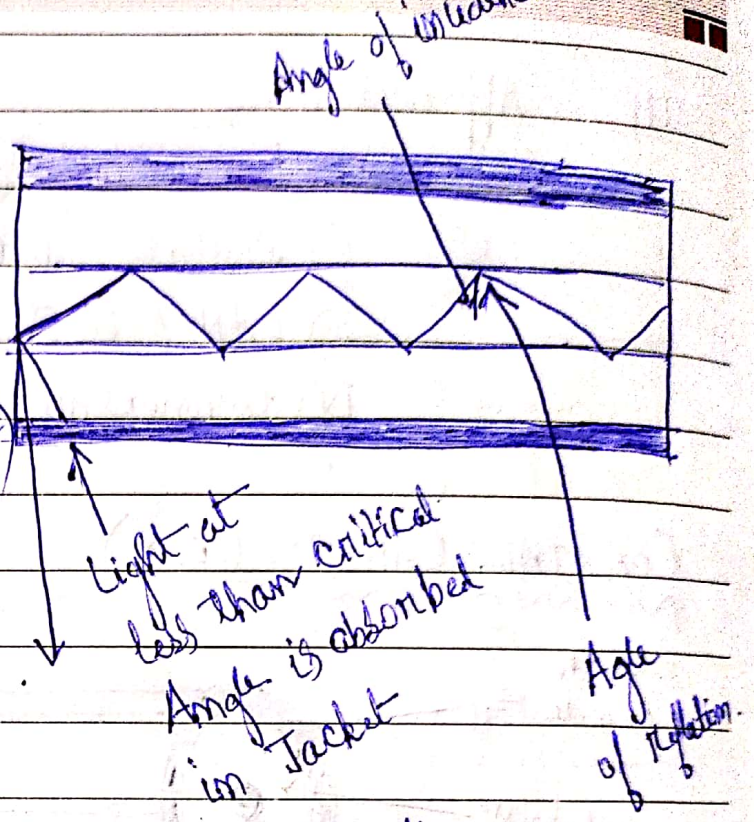
i) Television Distribution (Cable TV)
ii) Long distance Tel. Trans.
iv) LAN.

Category	Impedance	Use
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thick Ethernet.

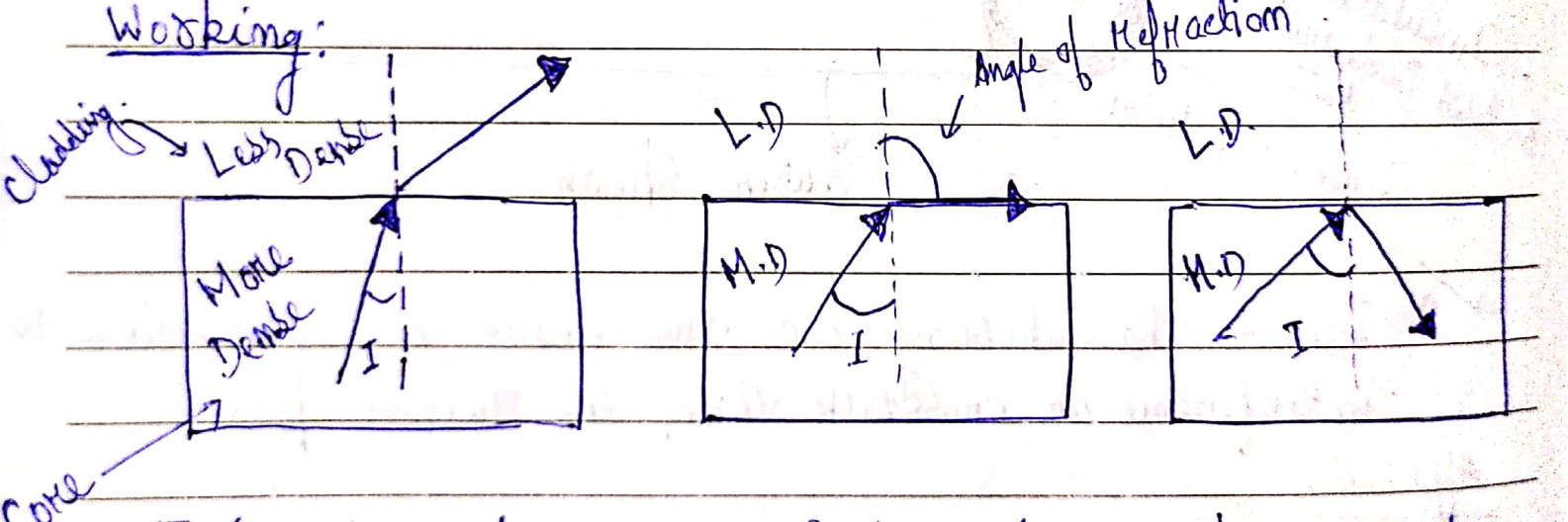
Notes

Optical Fiber:





Working:



I < Critical Angle Refraction

I = Critical Angle Refraction

I > Critical Angle Reflection

Communication Mode

- Multi Mode
  - Step Index
  - Gradual index
- Single Mode

i) Multimode :

↓

Variety of angles that will Reflect.

↓

Multiple Propagation Path.

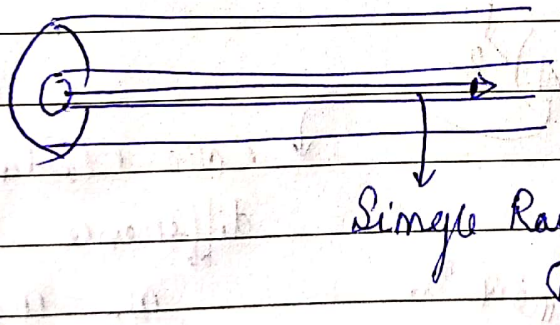
↓

Signal Elements Spread out in time

↓

Limits Data Rate.

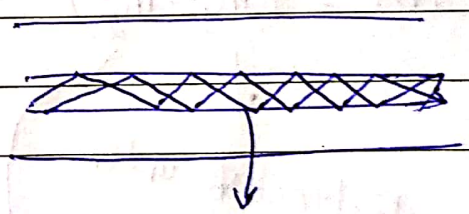
Single Mode:



Single Ray

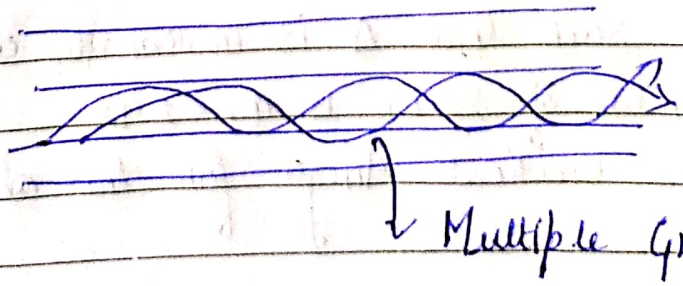
Multi-Mode.

Step-Indexed:



Multiple

Graded Index:



Multiple Graded Index.

Notes

Optical Fiber Types:

Type	Core (Nm)	Cladding (Nm) (Diameter)	Mode
50/125	50	125	Multi- G. Index
62.5/125	62.5	125	"
100/125	100	125	"
7/125	7	125	Single Mode :

Numerical Aperture :→ (NA)

$$NA = (n_1^2 - n_2^2)^{1/2} = n_1 (2\Delta)^{1/2}$$

- n_1 → Refractive index of the core
- n_2 → Refractive index of the cladding
- Δ → Core cladding index difference, $n_2 = n_1(1-\Delta)$

* i) n_2 is chosen such that Δ is normally 0.01
ii) For fibers made of Silica is $n_1 = 1.48$
iii) Find out the critical Angle for the above Situation

Notes

Light Sources / Detectors :→

i) Light Emitting Diode (LED)
ii) Injection Laser Diode (ILD)
iii) Detectors : PIN Photo