HindPhotostat

GET IT ON Google Play

Hind Photostat & Book Store

Best Quality Classroom Topper Hand Written Notes to Crack GATE, IES, PSU's & Other Government Competitive/ Entrance Exams

MADE EASY

ELECTRONICS ENGINEERING

Advance Commucation

By-Naveen Sir

- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

Visit us:-www.hindphotostat.com

Courier Facility All Over India
(DTDC & INDIA POST)
Mob-9311989030

HindPhotostat

GET IT ON Google Play

ALL E K ALL STUDY D / K

EASY , ACE KREATRYX

ESE , **BEST** Y KW , / E

E D/E/D D W **@**

1. KE E /E / **2.** E /E /

D , E /E / **4.** / E /E /

/E D E /KE E /E / **6.** KD /

,GATE , TEST @

- ❖ –W / **&** D /
- ❖ **GATE**
- ➢ E **- ALL** E /E / E
- ➢ **ALL** s W / **YEAR** Y /KE W **@**

W / /K K -

EASY , **,ACE** **,KREATRYX ,GATE** / , **,GK**

, **YADAV, KD** D ,&K E /KE **,** **–GRAW** , D ,W KE...K s

/ K K @

HIND PHOTOSTAT AND BOOK CENTER F230, LadoSarai New Delhi-110030 Phone: 9311 989 030 9560 163 471	Shop No: 46 100 Futa M.G. Rd Near Made Easy Ghitorni, New Delhi-30 Phone:	F518 Near Kali MaaMandir LadoSarai New Delhi-110030 Phone:	Shop No.7/8 Saidulajab Market Neb Sarai More, Saket, New Delhi-30

Website: www.hindPhotostat.com

Contact Us: 9311 989 030

ADVANCE COMMUNICATION systems:-

PART–I
Optical communication (THz) systems
1) Introduction
2) Review of optics
3) Types of fibers
4) Loss/Attenuation
5) Light sources
6) Light detectors
7) Link design

PART–II (GHz)
cellular communication
1) Introduction
2) Cell splitting
3) Sectorization
4) Interferences
5) Roaming & Hand off
6) GSM, CDMA

PART–III (GHz)
microwave communication
1) Introduction
2) wave propagation
3) microwave antennas
4) Microwave communication
5) Satellite communication
6) Link design

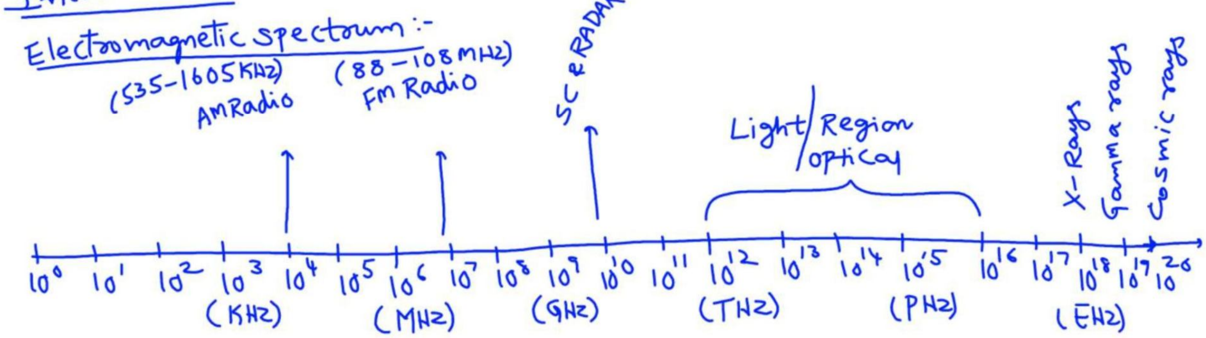
PART–IV (All frequencies)
Data communication
1) Introduction
2) OSI/ISO
3) Datalink layer
4) TCP/IP
5) Network layer
6) Transport layer
7) Application layer
8) Security

Optical communication systems:-

Introduction:-

$f = (10^{12} - 10^{16})$ Hz

Electromagnetic spectrum:-



BUR:- Bandwidth Utilization Ratio

BUR = 10% of f_c

BWR = 10% of f_c

f_c = 10 MHz

BWR = $\frac{10}{100} \times 10$ MHz

BWR = 1 MHz

f_c = 10 GHz

BWR = $\frac{10}{100} \times 10$ GHz

BWR = 1 GHz

f_c = 10 THz

BWR = 1 THz

Light Region :- is divided into three regions
1) InfraRed Region
2) Visible Region
3) U.V Region

InfraRed (IR)
- Near
- Mid
- FAR
- FAR FAR

[λ = 770 nm to 10^6 nm]

VISIBLE
- violet
- Indigo
- Blue
- Green
- Yellow
- orange
- Red

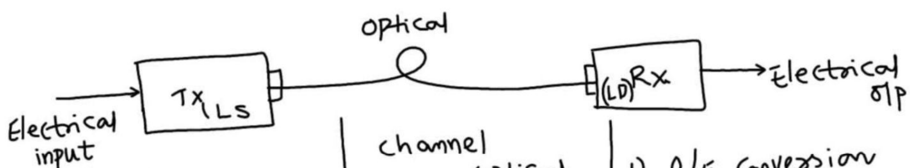
[λ = 390 nm to 770 nm]

UV region
- Near
- FAR
- extreme

[λ = 10 nm – 390 nm]

optical Communication systems uses IR :-

Basic Block diagram of OC :-

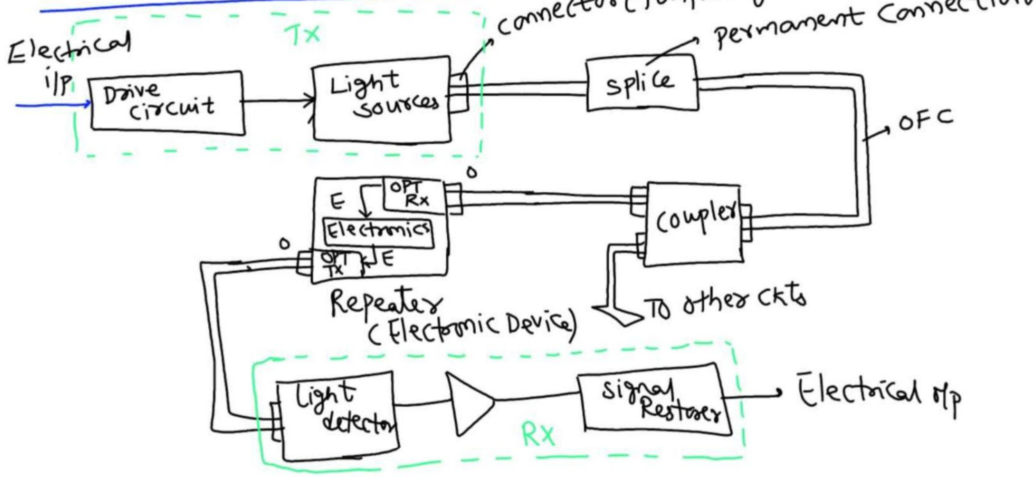


Task :-
1) E/O Conversion
2) Light soures
   1) LED
   2) LASER
3) Intensity modulation
   1 – ON
   0 – OFF

channel
- → OFC (optical Fibre cabel)
- → optical signals
- → Dielectric nature
- → Made up of
  1) Glass
  2) plastic

1) O/E Conversion
2) Light detectors
   1) PIN PD
   2) APD (Avalanche Photo Diode)
3) Decision making

Elements of optical communication systems:-



Notes:-

1) In OC, Light signals replace the electrical signals
2) The OC uses light as the carrier signal and whose frequency ranges from 10^{12} to 10^{16} Hz
3) In OC, the wavelength or band is 800 nm to 1600 nm

Advantages of OC:-

1) High BW
2) less loss
3) less interference
4) security
5) Abundant Raw material
6) less weight

Disadvantages of OC:-

1) Cost is high
2) less strength
3) Remote power supply (Repeater)
4) specialized technicians are required

Review of optics :-

1) Nature of Light :-

Dual nature

1) Wave Nature — Maxwell

$$C = \frac{1}{\sqrt{\mu_0 \epsilon_0}} = 3 \times 10^8 \, m/s$$

2) Particle Nature — plank, Einstien

$$E_p \propto f$$

$$\boxed{E = h \times f}$$ where h = plank's constant

$h = 6.626 \times 10^{-34}$ J-s

$$\boxed{E_p = \frac{h \times c}{\lambda}}$$ f = frequency of light emitted (Hz)

$$E_p = \frac{6.626 \times 10^{-34} \times 3 \times 10^8 \, m/s}{\lambda}$$

$$\boxed{E_p = \frac{1.24}{\lambda(\mu m)} \, eV}$$

③ Optical power :-

It measures the rate at which electromagnetic wave transfers light energy.

$$P = \frac{d\phi}{dt}$$

It is measured in dBm or dBμ

$$P(dB) = 10 \log_{10}\left(\frac{P}{1W}\right) \, dB/dBW$$

$$P(dBm) = 10 \log_{10}\left(\frac{P}{1 \times 10^{-3}}\right) \, dBm$$

$$P(dB\mu) = 10 \log_{10}\left(\frac{P}{1 \times 10^{-6}}\right) \, dB\mu$$

$$\boxed{\begin{aligned} dB &= dB \pm dB \\ dB &= dBm - dBm \end{aligned}}$$

Refractive Index (μ) / (n) :-

$$n = \frac{\text{velocity of light in Vaccum}}{\text{velocity of light in medium}}$$

$$\boxed{n = \frac{c}{v}} \quad n \geq 1$$

$$\boxed{n = \sqrt{\epsilon_r}}$$

For vaccum $v = c$
$n = 1$

For air $n = 1.00003 \simeq 1$

Water $n = 1.33$

Ethyl alcohol $n = 1.36$

Fused Quartz $n = 1.46$

glass $n = 1.5$

Diamond $n = 2.42$

1) The more dense the material ($n \uparrow$) then the less amount of light passes through it ($v \downarrow$) $\uparrow n = c/v \downarrow$

Thus $n > 1$ for all materials

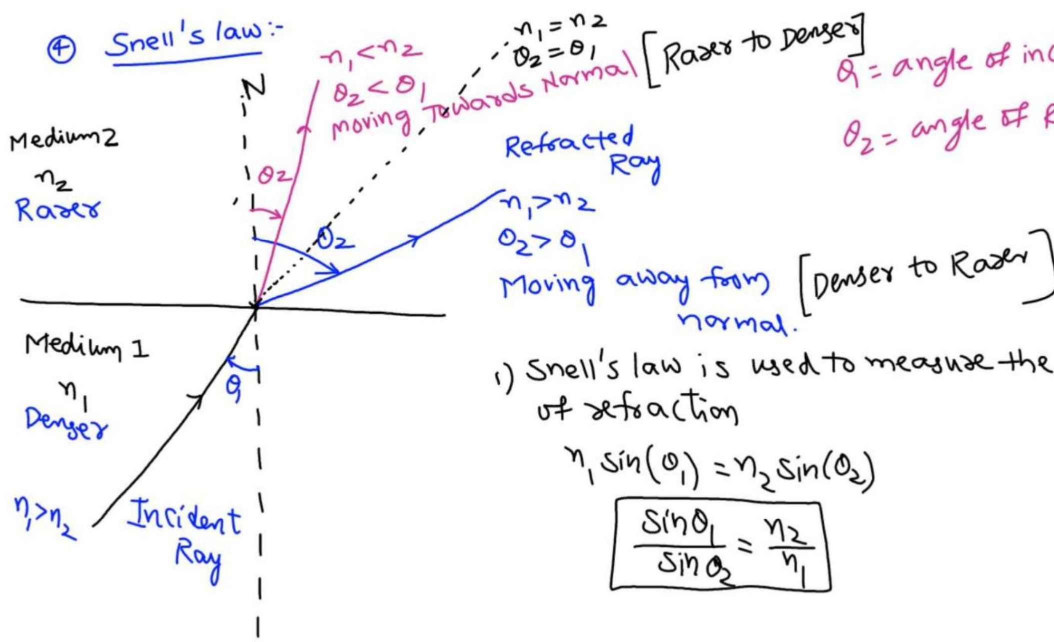
2) The frequency of light doesn't changes when it moves from one medium to another medium

$$\lambda_0 = c/f \Rightarrow c = \lambda_0 f$$

$$\lambda = v/f \Rightarrow v = \lambda f$$

$$n = c/v = \frac{\lambda_0 f}{\lambda f} \Rightarrow \boxed{n = \frac{\lambda_0}{\lambda}}$$

④ Snell's law :-



θ_1 = angle of incidence

θ_2 = angle of Refraction

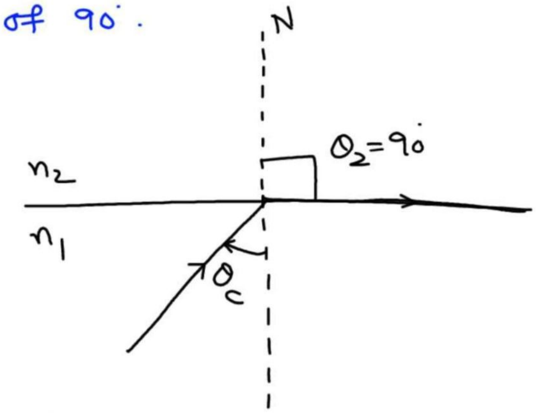
1) Snell's law is used to measure the angle of refraction

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

$$\boxed{\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}}$$

⑤ Critical Angle (θ_c):-

It is defined as minimum angle of incidence at which a light ray may strike the interface of two media and result in an angle of refraction of 90°.



$$\theta_c = \theta_1 \Big|_{\theta_2 = 90°}$$

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$$

$$\frac{\sin\theta_c}{\sin 90°} = \frac{n_2}{n_1}$$

$$\sin\theta_c = \frac{n_2}{n_1}$$

$$\boxed{\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)}$$

⑥ Total Internal Reflection (TIR):

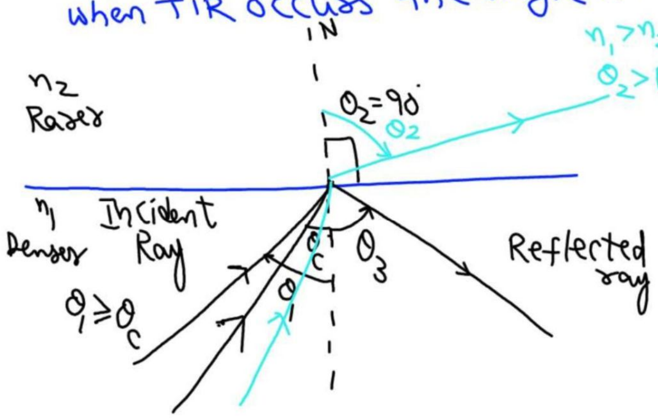
① It is the principle of OC systems.

② If the angle of refraction is 90° or greater then the light ray will not allowed to penetrate less dense medium so the light is reflected into the same medium

when TIR occurs the angle of incidence = Angle of reflection $\boxed{\theta_1 = \theta_3}$ $(\theta_1 \geq \theta_c)$

$n_1 > n_2$

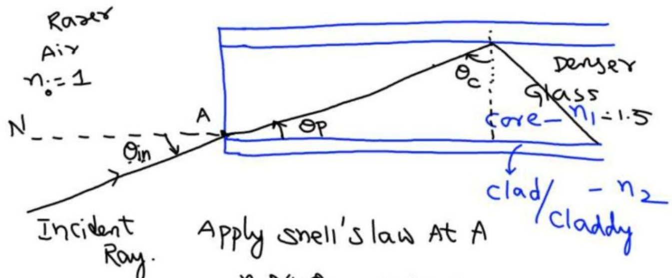
$\theta_2 > \theta_1$



To provide TIR the angle of incidence is greater than or equal to the critical angle.

⑦ Acceptance Angle (θ_a) / θ_{in} :-

θ_p = propagation angle



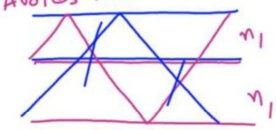
Apply Snell's law At A

$$n_0 \sin\theta_{in} = n_1 \sin\theta_p$$

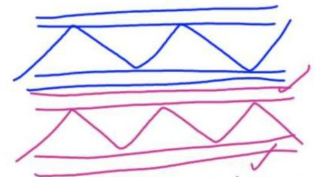
$$\boxed{\sin\theta_{in} = n_1 \sin\theta_p}$$

Uses of clad:-

① Avoids interference

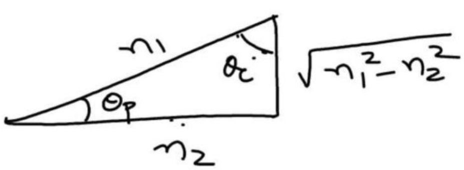


Interference



② Increase mechanical strength

③ Avoid Contamination to fiber



$$(hyp)^2 = (opp)^2 + (Adj)^2$$

$$Adj = \sqrt{(hyp)^2 - (opp)^2}$$

$$\sin\theta_c = \frac{n_2}{n_1} = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\boxed{\sin\theta_p = \frac{\sqrt{n_1^2 - n_2^2}}{n_1}}$$

$$\cos\theta_p = \frac{n_2}{n_1}$$

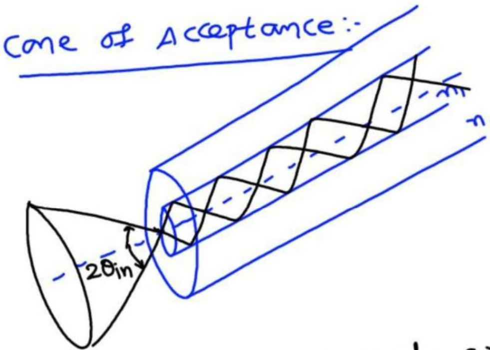
$$\sin\theta_{in} = n_1 \sin\theta_p$$

$$\sin\theta_{in} = n_1 \cdot \frac{\sqrt{n_1^2 - n_2^2}}{n_1}$$

$$\sin\theta_{in} = \sqrt{n_1^2 - n_2^2}$$

$$\boxed{\theta_{in} = \sin^{-1}\left(\sqrt{n_1^2 - n_2^2}\right)}$$

Cone of Acceptance :-



θ_{in} defines the maximum angle in which light ray may strike the boundary and still propagate down the fibre.

Rotating the acceptance angle around the fibre core axis describes the cone of acceptance

Solid acceptance angle $\Omega = \pi (NA)^2$ steradians

$$\Omega = \pi(\sin\theta_{in})^2$$

⑧ Numerical Aperture :- (NA) Light gathering ability of fibre.

① NA describes the Light gathering ability of fibre is NA.

② The FOM (Figure of Merit) of optical cable is NA.

③ NA is used to measure the magnitude of acceptance angle.

$$NA = \sqrt{n_1^2 - n_2^2}$$

$$\sin\theta_{in} = \sqrt{n_1^2 - n_2^2}$$

$$\boxed{NA = \sin\theta_{in}}$$

$$\boxed{\theta_{in} = \sin^{-1}(NA)}$$