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By-Naveen Sir

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Advance communication system

ESE :
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⊛ Syllabus *

① Optical communication (THz)
- (i) introduction
- (ii) Review of optics
- (iii) Types of fibers
- (iv) Attenuation
- (v) light sources
- (vi) light detectors
- (vii) Link design

(2) Cellular communication → (GHz)
- (i) introduction
- (ii) frequency reuse.
- (iii) hand off & Roaming.
- (iv) GSM
- (v) CDMA

(3) Microwave communication – (GHz)
- (i) Wave Propagation
- (ii) Microwave antennas
- (iii) Satellite communication
  - (A) classification of satellites
  - (B) GEO
  - (C) Link Design

(4) Data communication –
- introduction
- Protocals
- OSI
- TCP/IP
- Data link layer
- Network layer
- Transport layer
- Application layer
- Security
- Applications — ⊛ISDN, ⊛PSDN

Books:

① Wayne Tomasi → electronic communication system (fundamental to Advance)

② Datacomm and networking — Forouzan

(3) optical comm — senior

(4) Satellite comm — Pratt

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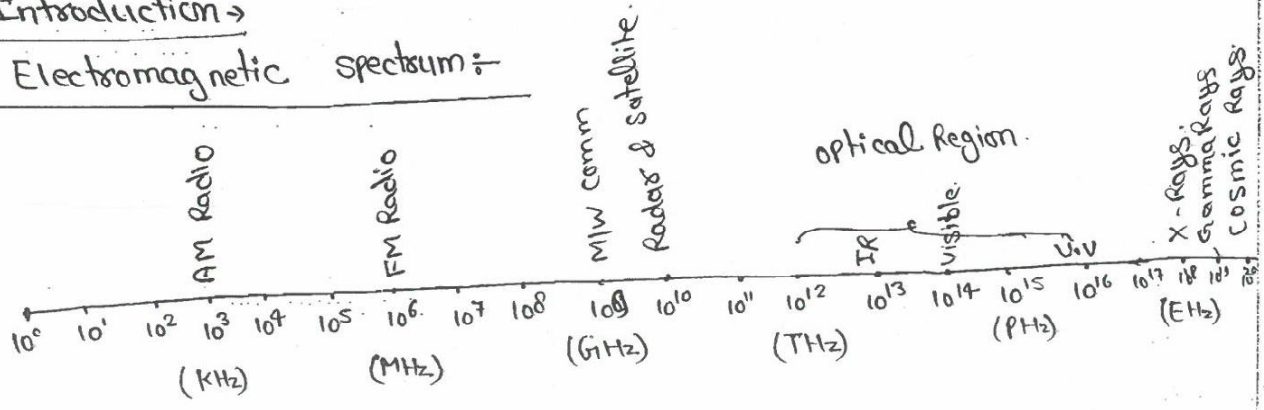
Optical communication

lecture -①

Introduction →

* Electromagnetic spectrum :-



(1) BUR → 10% of f_c (carrier frequency)

$$BUR = \frac{10}{100} \times f_c$$

$\therefore f_c = 10\,KHz$

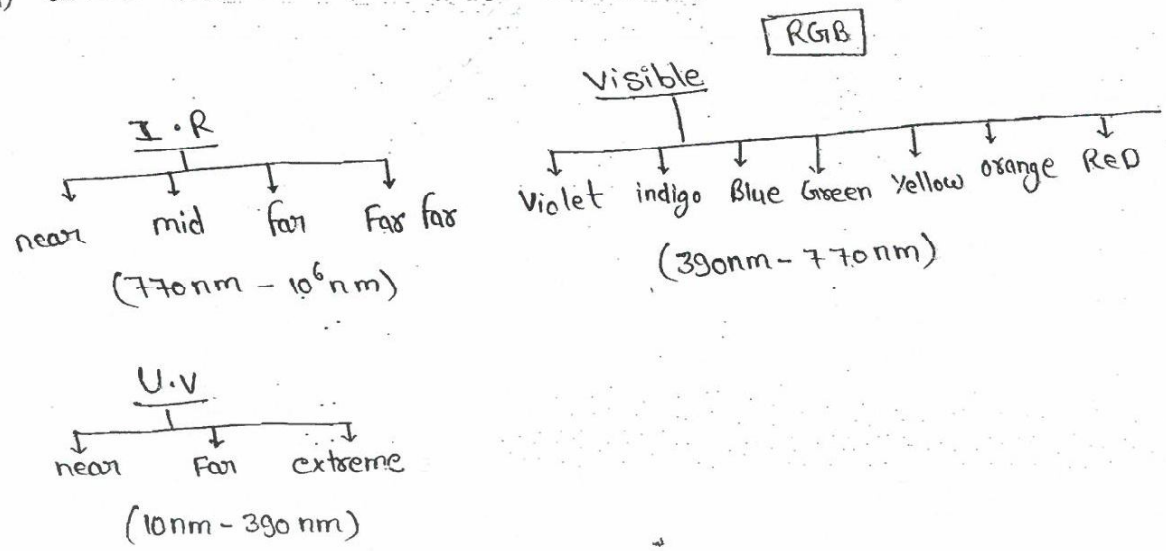
$$BUR = \frac{10}{100} \times 10\,KHz$$

BUR = 1 KHz

$\therefore f_c = 10\,THz$

BUR = 1 THz

(2) when deal with UHF we use wavelength instead of frequency



Infrared region → * The band of light frequencies i.e. to high to be seen by the human eye with wavelength ranging from (770nm - 10^6 nm).

Optical communication system generally operate in infrared region.

Visible light →

* The band of light freq to which human eyes will respond with wavelength ranging from (390nm - 770nm).
* This band will be visible to the human eye.

U.V region → the band of light freq that are too small to seen by the human eye with wavelength ranging from (10nm - 390 nm)

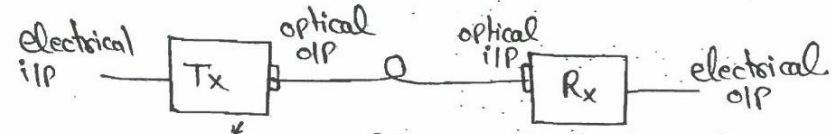
BUR → (Bandwidth utilization ratio) →

* The Bandwidth of comm system is 10% of the carrier frequency.

*ELF (extreme low frequency) ⇒ 30Hz - 300Hz.

* Voice frequency (VF) → 300Hz - 3.5KHz
* Very low frequency (VLF) → 3KHz - 30KHz
* Low frequency (LF) → 30KHz - 3MHz (AM radio)
* High frequency (HF) → 3MHz - 30MHz (SW_1, SW_2 SW_3 ... SW_7)
* Very high frequency (VHF) → 30MHz - 300MHz
* Ultra high frequency (UHF) → 300MHz - 3GHz
* SHF → 3GHz - 30GHz
* EHF → 30GHz - 300GHz
* Microwave frequencies → (1GHz - 1000GHz)

Simple Block diagram of O.C ⇒



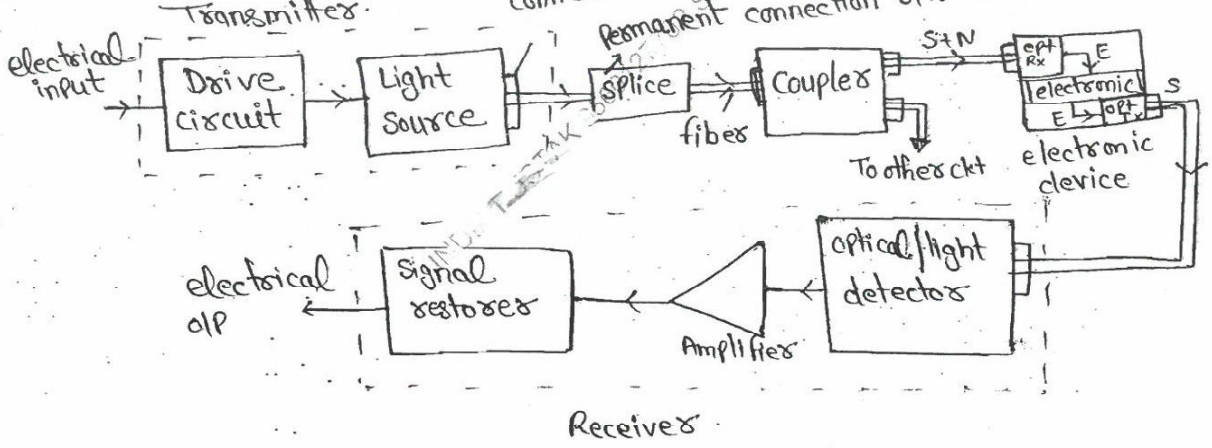
* E/o conversion
* Light Sources
  * LED
  * LASER/ILD
* intensity modulation
  1-ON, 0-OFF

OFC
* Dielectric in nature
Material →
① Glass
② Plastic

* O/E conversion
* Light detectors
  (i) PIN P.D
  (ii) A.P.D
* Signal restores

Carrier → optical/light signal
frequency → 10^{12} to 10^{16} Hz

* Elements of optical communication systems :-



* **Drive circuit →** The drive ckt serves as electrical interface b/w the input circuitry and the light source.

The drive ckt converts an i/p sig voltage to a current i.e used to drive the light source.

* **light source** - * The light source converts electrical i/p into optical o/p (E/o) conversion.
  * The light source is either LED (or) LASER.
  * The amount of light emitted by Light source is proportional to the amount of drive current.

Connector → connector is a mechanical interface which provides temporary connection b/w light source & fiber, fiber & fiber and fiber & light detector.

Splice → splicing provides permanent connection b/w fiber & fiber.

light detector → * The optical energy is converted into electrical energy (O/E conversion).

* The light detectors are generally PIN, A.P.D or Photo transistor.
* all these devices convert light energy to current.

Advantages of optical communication system →

① B.W is high.
② Loss is less
③ more distance, transmission.
④ High safety
⑤ less interference.
⑥ More security
⑦ Abundant raw material.
⑧ Reliability
⑨ Less weight

Disadvantages

① Cost is high
② special training & equipment is required
③ External Power supply (or) remote electrical supply.
④ B.W is not utilised efficiently.
⑤ strength is less. bcz of brittle nature.

* Review of optics :-

* Nature of light →

Dual nature

① wave nature - Maxwell's

$$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \qquad [C = 3 \times 10^8 \text{ m/sec}]$$

② Particle nature - Plank & Einstien →

$$E_p \propto f$$

$$E_p = hf \qquad [h = 6.626 \times 10^{-34} \text{ J-sec}]$$

$$E_p = \frac{h \times c}{\lambda}$$

$$\lambda = \frac{h \times c}{E_p}$$

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

* Optical Power / Radiant flux (ϕ) :-

$$P = \frac{dQ}{dt}$$

$$P(dB) = 10 \log_{10}(P) \text{ dB}$$

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

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

$$dB \pm dB = dB$$

$$dBm - dB = dBm$$

$$dBm - dBm = dB$$

Note →

* Refractive index (n) ⇒

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

$$\boxed{n = \frac{c}{v}}$$

$c = \lambda_0 f$

$v = \lambda f$

$n = \frac{\lambda_0 f}{\lambda f}$

$\boxed{n = \frac{\lambda_0}{\lambda}}$ $\boxed{n = \sqrt{\varepsilon_r}}$

for vaccum → $v = c$

$\boxed{n = 1}$

for air → $n = 1.00003$

$\boxed{n = 1}$

for water → $\boxed{n = 1.33}$

for ethyl alcohol → $\boxed{n = 1.36}$

for fused quartz → $\boxed{n = 1.46}$

Glass → $\boxed{n = 1.5}$

for diamond → $\boxed{n = 2.42}$

Silicon → $\boxed{n = 3.4}$

definition → * optical Power is described as flow of light energy Passed at given point in specified time.

* It is measured in dBm or dBu.

* Refractive index is defined as the ratio of velocity of Propagation of light in vaccum to the velocity of Propagation of light in medium.

* The freq of light does not changes when it passes from one medium to another but the wavelength must change.