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Degree Bs (Tele)

Assig # 1

Subject Optical communication

Submitted to

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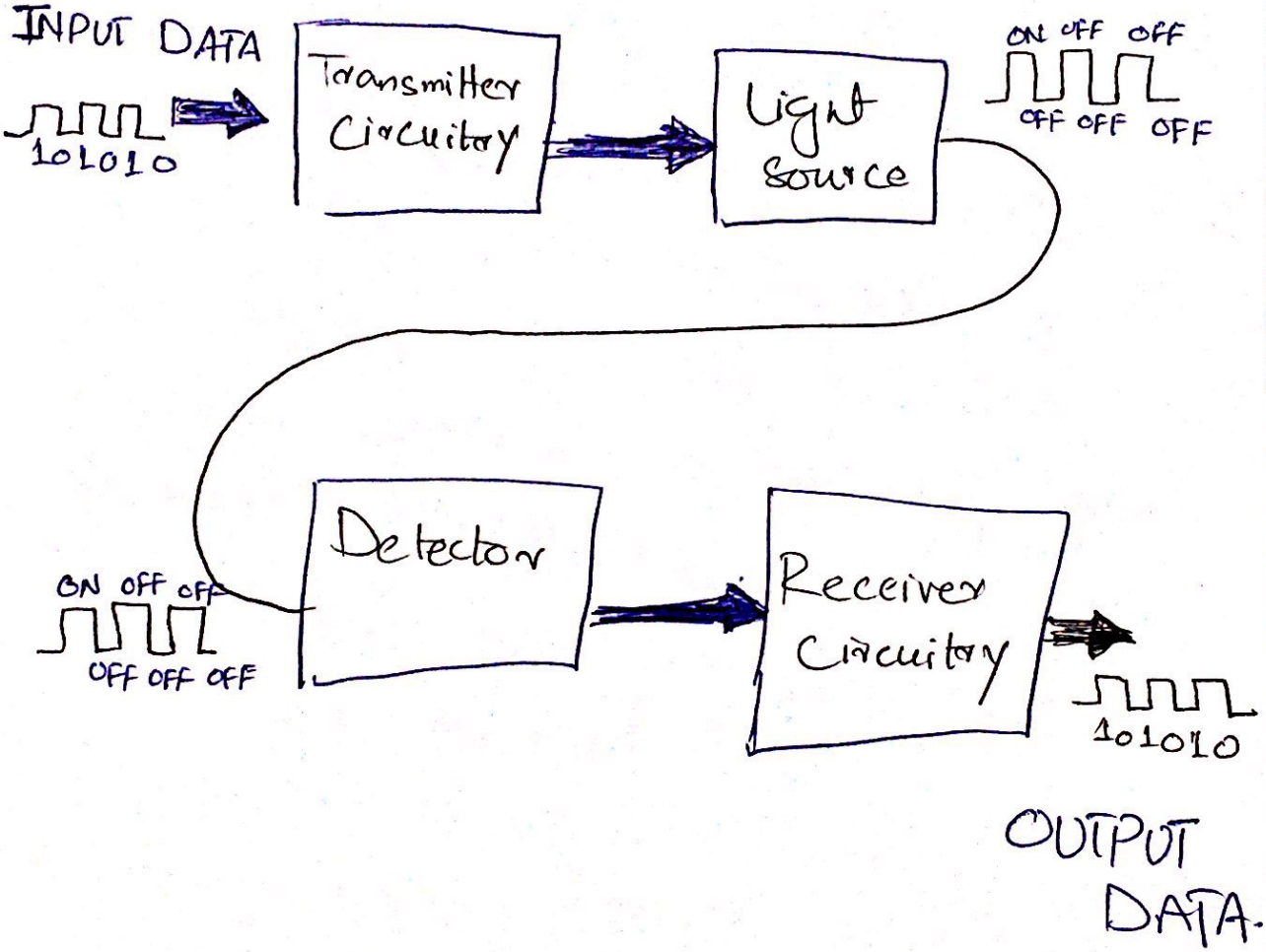
(Q1)

What are the basic blocks of fiber optic communication system, Explain it.

(Ans) When the input data in the form of electrical signals is given to the transmitter circuitry it converts term into light signal with help of a light source. This source is of LED whose amplitude, frequency and phases must remain stable and free from fluctuation in order to have efficient transmission. The light beam from the source is carried by a fiber optic cable to the destination circuitry wherein the information

is transmitted back to the electrical signal by a receiver circuit.



Q2 Define the following:

* Wavelength and Period:-

A wavelength has a wavelength λ, which is the distance between adjecent identical parts of the wave. The wave velocity and the wavelength are related to the wave's frequency and Period by $vw = \lambda T$ or $vw = f\lambda$. The time for one complete cycle is the period T.

* Refractive Index

In optics the refractive Index or Index of refraction of a material is a dimensionless number that describes how fast light travels through

through the medeval. It is defined as where C is the speed of light in the medium.

And { The ratio of the velocity of light in a vaccum to its velocity is a specified medium.

* Total Interval Reflection

Total internal reflection, In physics complete reflection of a ray of light with in a medium such a water or glass from the surrounding surfaces back into the medium. The Phenomena occurs. if the angle of incidence is greater then a certain limiting angle called the critical angle.

* Critical Incident angle and Critical Propagation angle.

A ray incident at the core-cladding boundary at the critical angle is called critical ray. The Critical ray makes an angle with axis of the fiber. If the fiber ray propogation an angles larger than will not Propagate in the fiber. Therefore, the angle is called the critical propagation angle.

(Q 4) calculate the maximum transmission distance for a fiber link with with an attenuation of 0.4dB/km if the power launched is 1mw and the receiver is 40 uw?

Sol

Just Plug the number into formula

$L = (10/A) \log_{10}(P_{in}/P_{out})$

$L_{max}(km) = (10/A) \log_{10}(P_{in}/P_{out})$

$L_{max}(km) = (10/0.4) \log_{10}(P_{in}/P_{out})$

$L_{max}(km) = 10/0.4) Log_{10}(22)$

$L_{max}(km) = 17.629\ km$

Q6 What is Chromatic Dispersion? Explain the types of chromatic Dispersions occur in the single mode fiber.

(Ans) In optics, dispersion is the phenomenon in which the phase velocity of a wave depends on its frequency. Media having this common property may be termed dispersive media. Sometimes the term chromatic dispersion is used for specificity.

⇒ Chromatic dispersion in a single mode fiber
⇒ waveguide dispersion is also a type of chromatic dispersion It is a function of fiber core size.

Contin—

V-number, wavelength and light source linewidth while the difference in refractive indices of single mode fibres core and cladding are minuscule, they can still become a factor over greater distances.

(Q7)

Define the following terms.

* Transparent windows:-

Let the operating system's desktop show through, while opaque windows obscure the desktop area behind them. A window that uses system chrome is always opaque.

* Mode field Diameter:-

In fiber optics, the mode field diameter is an expression of distribution of the irradiance i.e the optical power per unit area, across the end face of a single mode fiber

* Polarization mode dispersion

Polarization mode dispersion is a form of modal dispersion where two different polarizations of light in a waveguide, which normally travel at the same speed, travel at different speed due to random imperfections and asymmetries, causing random spreading of optical pulses.

* Inter Modal Dispersion

Inter modal dispersion (also called modal dispersion) is the phenomenon that the group velocity of light propagating in a multimode fiber (or other waveguide) depends not only on the optical frequency (→ Chromatic dispersion) but also on the propagation mode involved.

Q8 calculate pulse spread caused by polarization mode dispersion of $D_{PMD} = 0.4 ps/\sqrt{km}$ and $L = 200 km$

Sol

$D_{PMD} = 0.4 ps/\sqrt{km}$

and length $L = 200 km$

As ΔT caused by PMD is proportional to $\sqrt{L}$

$$D_{PMD} = 0.4 ps/\sqrt{200}$$

$$D_{PMD} = \frac{0.4 ps}{14.14} = 0.0283$$

$$\boxed{D_{PMD} = 0.0283}$$

(Q9) A single mode fiber has the following parameters core diameter $d = 7.3\ \mu m$, core refractive index (n_1) = 1.4692 and relative index (Δ) = 0.36% calculate the V number at the 1500 nm operating wavelength.

Sol

Parameter of optical fiber given by the relation.

$$V = \frac{2\pi a}{\lambda} \sqrt{\mu^2_{core} - \mu^2_{clad}}$$

Where is the radius of core and λ is free space wave length.

=) The maximum number of modes (N_m) supported by a single mode step index fiber fiber is determine by

$$N_m = \frac{1}{2}V^2$$

=> If $V < 1500\,nm$ the fiber will support only one mode and known single mode optical fiber.

=> If $V > 1500\,nm$ the fiber will support many modes simultaneously. This is known as a multimode fiber

The wavelength corresponding to the value $V = 1500\,nm$ known as cutoff wavelength expressed as.

$$\lambda \frac{\lambda V}{2.405}.$$