Name Younas Khan

ID 12422

Subject optical Communication

Semester 10th

Sessional assignment

submitted to Sir Mansoor Qadir

Submitted by younas khan

Date:.....

① What are the basic blocks of fiber optic communication systems, explain it?

Ans:- The optical fiber consists of three main elements.

① Transmitter : an elements signal is eapplied to the optical transmitter. The optical transmitter consists of driver circiut, light source and fiber flylead. Driver circuit the light source. light source converts electrical signal to optical signal.
fiber flylead is used to connect optical signal to optical fiber.

② Transmission channel. it consists of a cable that provide mechanical and envisomental protecation to the optical fibers contained inside. each optical fiber act as an individual channel.
optical splice is used to permemently join two individual optical fibers.
• optical connecator is for temparary non-fixed joints between two individual optical fibers.

Date:.....

optical ~~splice~~ couplers or splitters provides signal to other device.

- Repeater converts the optical into electrical signal using optical seciver. and passes it to electronic circuit where it reshaped and amplified. as it gets attenuatted and disorted with increassing distance because of scattering absorption and dispersion in wareguides and the end this signal is them again converted into optical signal by the optical transmitter.

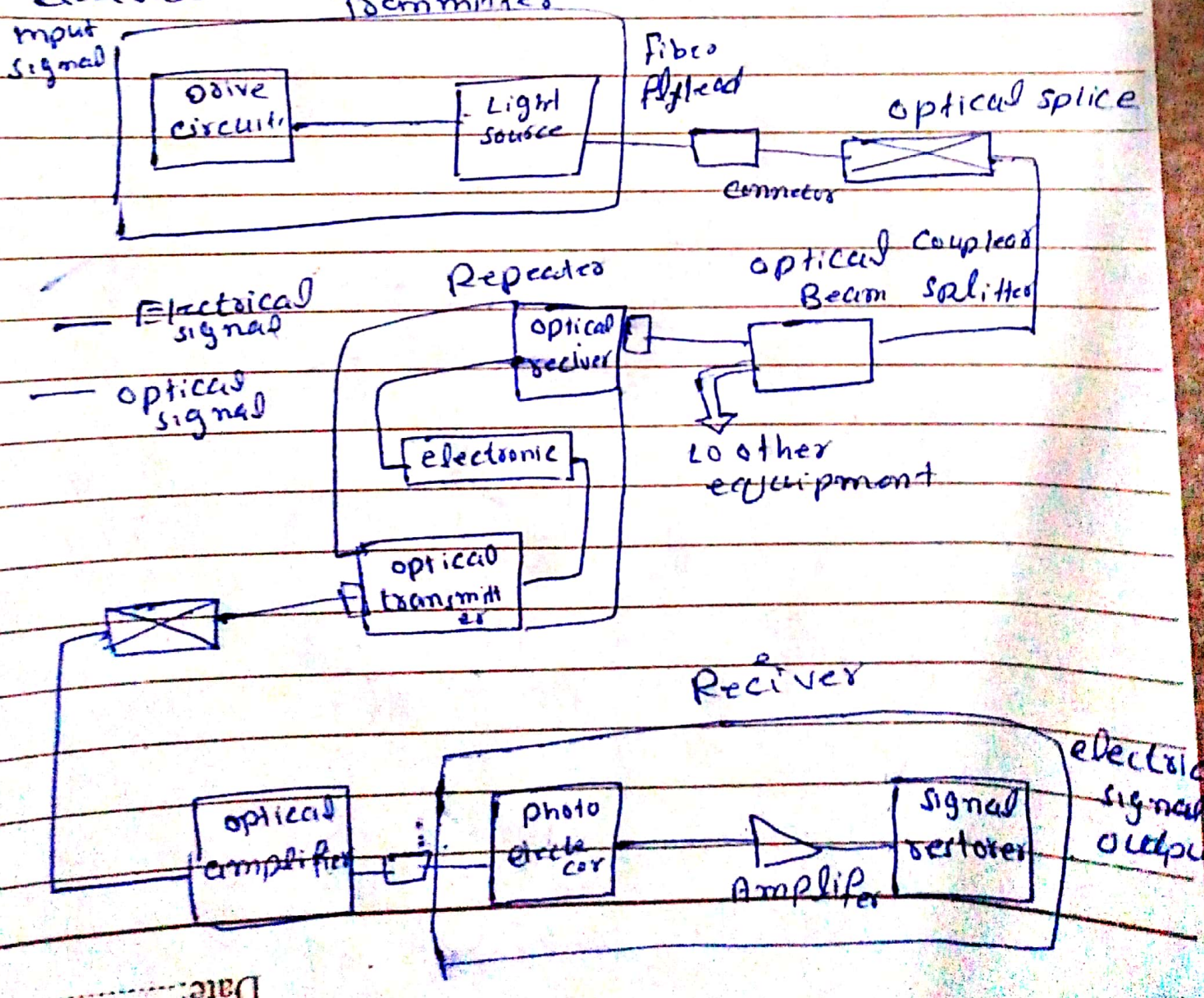
③ Reciver : optical signal is applied to the optical reciver, it consists of photon detecor, amplifier and signal restorer.

photo detector convert the optical signal to electrical signal.

Signal restorers and amplifiers are used to improve signal to noise ratio of the signal as three are chance of noise to be introduce in the signal due to the use of photo detectors

* for short distance communication only ~~there~~ is need for ~~are~~ required.
main elements

Couplers, source - LED
Fiber - multimode step index fiber
Detector - PIN detectors.
For long distance communication along with main elements these is need for couplers, beam splitters, repeaters optical amplifiers.
Source - LASER diode
fiber - single mode fiber
Detector - Avalanche photo diode (APD).



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Date:.....

Q2:- Define the following.

*(1) Wavelength and period

Wavelength is the distance from one crest to another. or from one trough to another, of a wave, which may be an electromagnetic wave a sound wave.

and the wavelength are related the wave frequency and period by $VW = \lambda T$ or $VW = f\lambda$. The time for one complet cycle is the period T.

(2) Refractive index :- Refractive index is also called index of refraction measure of the bending of a ray of light when passing from one medium into another. if i is the angle of of incidence of a ray in vacum.

(3) Total internal reflection :- Total internal reflection is also called is the reflection of the amount of incident light at the boundary between two media. total internal reflection. The complete reflection of a light ray reaching an interface with less dense medium when the angle of incidence exceeds the critical angle

Date:.....

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 fibers. If the rays propagation on angles larger then will not propagate in the fibers. Therefore, The angle is called the critical propagation angle.

④ NO3:. How many photons per second emanate from a laser diode (LD) radiating 1310nm and 1500nm if its power is 1mW

sol:.

The energy of a photon is given by the equation $e = hc/h$

E is the energy (0.010 joules per second because of laser is given as 1 mW.

h is plank's constant (value $= 6.626 \times 10^{-34}$ j.s

C is speed of light (value $= 3 \times 10^{8}$ m/s

$\lambda_1 = 1310 \times 10^{-9}$ m

$h_2 = 1500 \times 10^{-9}$

Date:.....

So

$$E = n \times e$$

$$e = hc/\lambda$$

$$= \frac{1310 \times 10^{-34} \times 3 \times 10^{8}}{1500 \times 10^{-9}}$$

$$e = 2.62 \times 10^{-35}$$

(4) Calculate the maximum transmission distance for a fiber link with an attenuation of 0.4 dB/km if the power launched is 1mw and receiver sensitivity is 40 μW.

$$P_s = \frac{N_p B h v}{2}$$

$$P_0 = P_i \cdot 10^{-\alpha/10}$$

$$L_{max} = \frac{10}{\alpha} \log\left(\frac{P_i}{P_s}\right) = \frac{10}{\alpha} \log\left(\frac{2P_i}{N_p B h v}\right)$$

$$L_{max} = \frac{10}{0.4} \log\left(\frac{2 \times 10^{-3} \times 1.3 \times 10^{-6}}{0.4 \times 40 \times 10^{-9} \times 6.62 \times 10^{-34} \times 3 \times 10^{2}}\right)$$

47Km

Date:.....

(5) Consider a model dispersion for step index multimode fiber with NA = 0.200 and $n_1 = 1.486$

$$\Delta t_{SI} = \Delta t_{SI} \left(\frac{\Delta n}{8} \right)$$

$$\Delta t_{SI} = 0.200 \left(\frac{1.486}{8} \right)$$

$$\Delta t_{SI} = 0.200 (0.18575)$$

$$= 0.03715$$

(6) What is chromatic dispersion? explain the types of chromatic dispersion occurs in the single mode fiber?

Ans:- In an optical medium such as fiber, there are three types of dispersion, chromatic modal and material chromatic dispersion result from the spectral width of the emitter. The spectral width

Date:.....

determines the number of different wavelength that are emitted from the LED as lases.

① Dispersion: Dispersion is also known as pulse spreading as pulse broading. Dispersion is caused by the delay of some of the optical power in a at the output end of the fiber. Dispersion causes an optical pulse width that increase continously through the fiber.

x Model Dispersion: In a fiber light can take two types of path.

All rays can travel along the same path and have same path length.

Rays can travel along different paths and have different path length.

Date:

* Transparent window :- eplain three operating windows in optical communication. in case of optical optical transmission the loss is wavelength dependent. so, there is a specific band of wavelength where the signal attenuation is minimum which is known as optical or Transparent window.

* Model field diameter :- in fiber optics, the mode field diameter (MFD) is an expression of distribution of the irradiance. i.e the optical power per unit area, across the end face of a ~~s~~ single-mode fiber.

* Polarization Mode dispersion :- polarization mode dispersion is a form of modal dispersion where two different polarization of light in a waveguide, which normally travel at the same speed, travel at different speeds due to random imperfection and asymmetries,

Date:.....

Causing random spreading of optical pulses.

* Intermodal Dispersion:- Modal dispersion is a distortion mechanism occurring in multimode fibers and other waveguides, in which the signal is spread in time because the propagation velocity of the optical signal is not the same for all modes.