IQRA NATIONAL UNIVERSITY PESH.

Final Term

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Programe : Bs (Telecom)

Subject : Optical Communication

Module : 8th Semester

Q1. PART. A). Explain the difference between inter-modal and intra-modal dispersion?

(Ans). Intermodel Dispersion :-

⇒ When a light Pulse is fed into the fiber it travel along the fiber through various mode of Propagation.

⇒ Each mode having it own propagation vector.

Intramodal Dispersion :-

⇒ Interamodal Dispersion is pulse spreading that accurs within a Signal mode fiber.

⇒ Intramodal dispersion is also known as chromatic dispersion.

⇒ And chromatic dispersion has two regions.

i). Material dispersion
ii). Waveguide dispersion

Q1. PART. B). What is the Pulse Spread Caused by material dispersion if $\Delta\lambda = 0.5nm$, $L = 2km$ and $\lambda = 1350nm$?

(Ans). As we know that

$$D_{mat}(\lambda) = mat(\lambda) \cdot \Delta\lambda$$

$$\because \; mat(\lambda) = \frac{20Ps}{1nm . 2km}$$

$$D_{mat}(\lambda) = \frac{20Ps}{1nm . 2km} . \Delta\lambda$$

$$= \frac{20Ps}{1nm . 2km} . 0.5$$

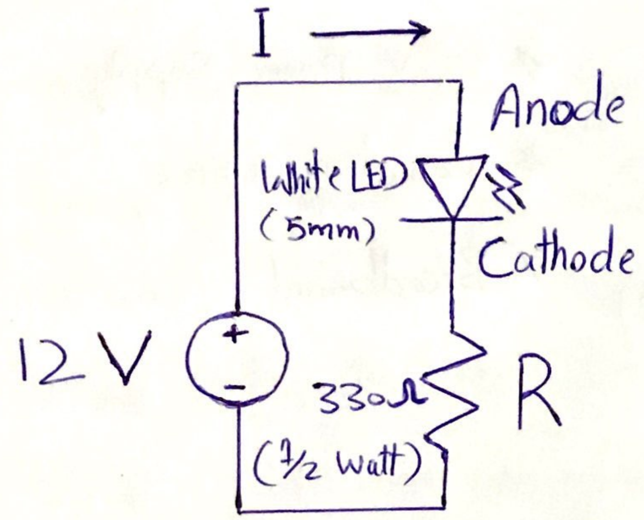
$$= 40 \times 0.5$$

$$\boxed{D_{mat}(\lambda) = 20Ps}$$

Q2. PART. A). Draw the electric Circuit of LED and explain the function of each Components?

(Ans).

⇒ Simple LED Circuit diagram:

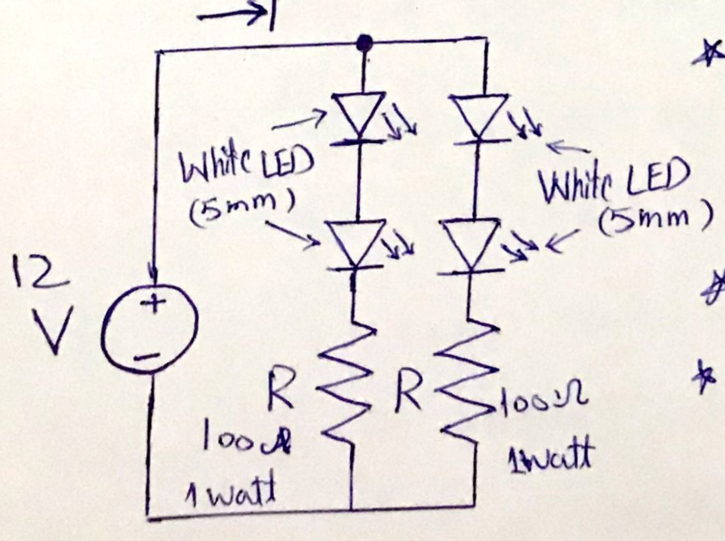


⇒ Components Required

* Power supply 12 V
* 5mm White LED
* 330Ω ½W Resistor
* Connecting wires
* Breadboard

⇒ ~~Series~~

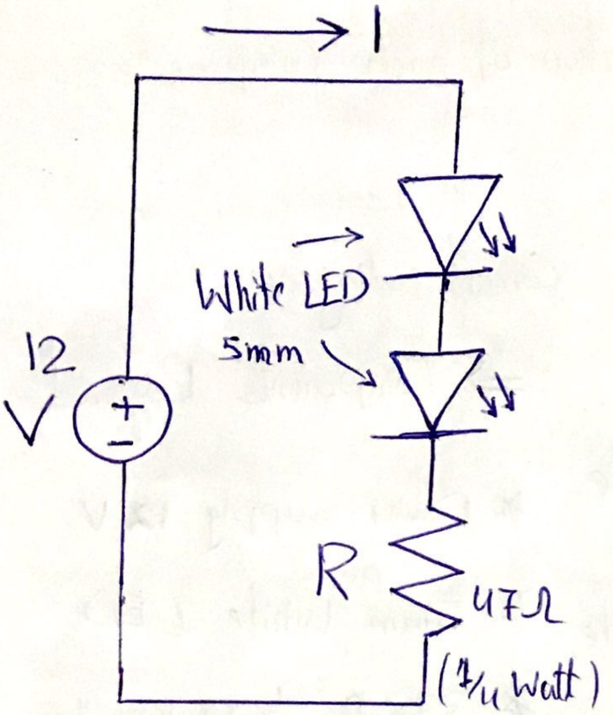
Parallel LED Circuit diagram:



⇒ Components Required

* 12 V Power Supply
* 4 x 5mm White LEDs
* 2 x 100Ω Resistor (1 watt)
* Connecting wires
* Breadboard

⇒ Series LED Circuit diagram :



⇒ Components Required

* 2 x 5mm White LEDs
* 47Ω Resistor (1/4) watt
* 12 V Power Supply
* Connecting wires
* Breadboard

Q2. PART. B). What is homostructured and hetero structured LED. Also explain the drawbacks of homostructured LED and how does heterostructured LED cater these problems?

(Ans) ⇒ Homostructured LED:

Homostructured makes the device radiates a broad light beam and make coupling into fiber efficient.

⇒ Heterostructured LED:

Most LED is designed using heterostructured because it gives good confinement of recombination process.

⇒ Drawbacks of Homostructured:

A Homostructured LED has two major drawback

1). It's active region is to deffuse, which makes the device's efficiency very low. This is because electron-hole recombinations take place in various location, that is over a large area a situation that requires high current density to ~~desired~~ support the desired level of radiated Power.

2). Second: This type of LED radiates a broadlight beam This makes the Coupling of this light into an optical fiber extremly inefficient and is the reason why you Can not find an LED with a homojunction in Practical application

⇒ Heterostructured LED Cater Problem:-

A double heterostructured is formed when two Semiconductor materials are grown into a "Sandwich"---- if one of the Cladding layers is p-doped, the other Cladding layer n-doped and the Smaller energy gap Semiconductor material undoped, a p-i-n structure is formed.

Q3. Explain these losses :

i. Attenuation :- In optical fibers, attenuation is the rate at which the Signal light decreases in intensity. For this reason, glass fiber (which has a low attenuation) is used for long distance fiber optic cables; Plastic fiber has a higher attenuation and, hence, Shorter range.

ii. Macrobending :- Optical fibers suffer from macro-bending loss at bends or curves on their Paths. This is due to the energy in the evanescent field at the bend exceeding the velocity of light in the Cladding and hence the guidance mechanism is inhibited, which Causes light energy to be radiated from the fiber.

iii. Microbending :- A microbend is a fiber imperfection. Microbends Cause an increase in Cable loss. This loss Can result in an excessively large loss in excess of 100 dB/km in Some Cases. A major Cause of this loss occurs during Cable manufacture.

iv. Scattering :- Rayleigh scattering sets a lower limit to the Propagation losses in optical fibers... Due to the high optical intensities Which often occurs in optical fibers, nonlinear Scattering Processes like Raman scattering and Brillouin Scattering Can also occur.

V. Absorption :- The attenuation of the optical fiber is a result of two factors, absorption and scattering. The absorption is Caused by the absorption of the light and Conversion to heat by molecules in the glass.
Primary absorbers are residual OH+ and dopants used to modify the refractive index of the glass.

Q4. PART. A). What is number of modes for graded - index fiber if $d = 50\ \mu m$, $NA = 0.250$ and operating Wavelength is 1330 nm ?

(Ans)

Solution :-

$d = 50\ \mu m$

$NA = 0.250$

$\lambda = 1330\,nm$

$N = ?$

As we know that

$$N = \frac{V^2}{4} \quad (A)$$

we also know that

$$V = \frac{\pi d}{\lambda} \cdot NA = \frac{3.14 \times 50 \times 10^{-6}}{1330 \times 10^{-9}} \times 0.250$$

$$V = 118.045 \times 0.250$$

$$V = 29.51 \rightarrow \text{Put in } (A)$$

$$N = \frac{(29.51)^2}{4} = \boxed{217.7}$$

Q.4. PART. B). Calculate pulse spreading due to materil dispersion in a single mode fiber operating at $\lambda = 1310$ nm if the LD'S $\Delta\lambda = 1$ nm and $L = 1$ km ?

(Ans)

Solution:-

We find that $D_{mat}(\lambda)$ at 1310 nm is approximatly 2 Ps/nm Subsitnting the number.

$$D_{mat}(\lambda) = mat(\lambda) \cdot \Delta\lambda$$

$$\because mat(\lambda) = \frac{2Ps}{1nm \cdot 1km}$$

$$D_{mat}(\lambda) = \frac{2Ps}{1nm\ 1Km} \cdot 1nm$$

$$D_{mat}(\lambda) = 2ps/km$$

$$\boxed{D_{mat}(\lambda) = 0.002\ ns/ks}$$