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Q1 (A) Explain the difference between inter-model and intra model dispersion?

(Ans) Intermodel :- Dispersion

When a light pulse is fed into the fiber it travel alone the fiber through various mode of propogation.

⇒ Each mode having it own propogation vector.

* Intra model Dispersion

⇒ Intermodel dispersion is pulse spreading that occurs within a signal mode fiber.

⇒ Intramodel dispersion is also known as chromatic dispersion.

→ And chromatic dispersion has two regions.

i) Material dispersion
ii) waveguide dispersion.

Part (B) What is the pulse spread caused by material dispersion if $\Delta\lambda = 0.5nm$, $L = 2Km$ and $\lambda = 1350nm$?

Sol

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

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

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

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

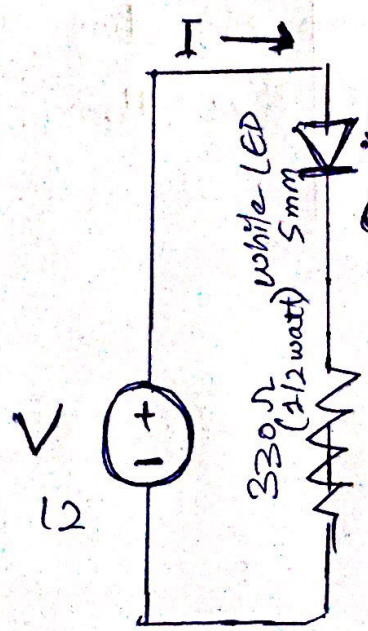
$$= 40 * 0.5$$

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

Ans

(Q2) Draw the electric circuit of LED (A) and explain the function of each components.

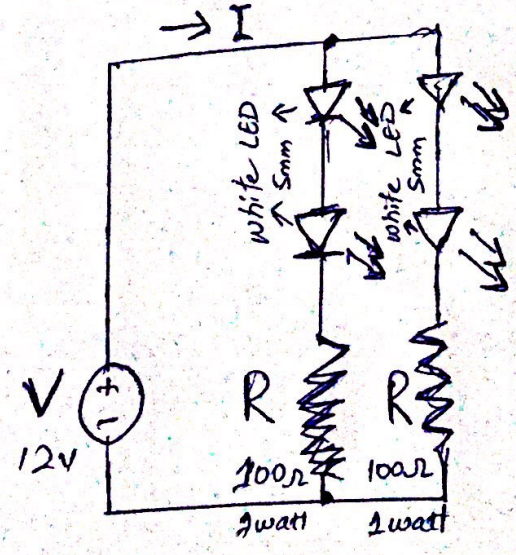
(Ans) Simple LED Circuit Diagram:-



Component Required

- 12 V Power Supply
- 5mm white LED
- 330Ω 1/2 Resistor
- Connecting wires
- Breadboard.

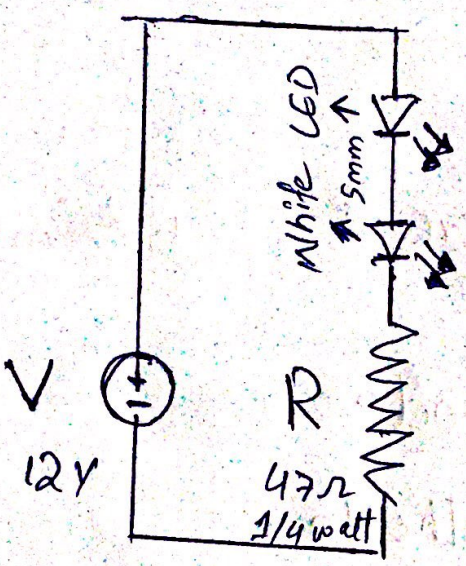
★ Parallel LED Circuit Diagram:-



Components Required

- 12V Power Supply
- 2x5m white LED
- 2x100Ω Resistor (1watt)
- Connecting wires
- Breadboard.

* Series LED Circuit Diagram



Component Required.

- ~~2X5mm~~ 12V power supply
- 47Ω Resistor (1/4 watt)
- 2X5mm White LED
- Connecting Wires
- Breadboard.

Q2 (B) What is homostructured and hetro structured LED. Also Explain the drawbacks of homostructured LED and how does hetro structured LED cater these problems.

(Ans) Homostructured LED:-

⇒ A homostructure makes the device radiates a broad light beam and make coupling into fiber in efficient.

★ Hetrostructured LED:-

⇒ Most LED is design using hetrostructure because its gives good confinement of recombination process.

★ Drawbacks of Homostructure:-

A homostructure LED has two major drawbacks.

i) Its active region is to diffuse, which make the devices 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 support the desired level of radiated power.

(2) Second: This type of LED radiate a broad light beam This makes the coupling of this light into an optical-fiber extremely inefficient and is the reason why you can not find an LED with a homojunction in practical applications.

★Hetro Structured LED Cater Problem

A double hetro structured is formed when two semiconductor material are grown into a sandwich.... if one of the cladding layers is p-doped the other cladding layer is n-doped and the smaller energy gap semiconductor material is undoped, a p-i-n structure is formed.

(Q3) Explain these losses.

(i) Attenuation:-

In optical fiber attenuation is the rate at which the signal light decreases in intensity for this reason, glass fiber (which has low attenuation) is used for long distance fiber optic cables.

⇒ Plastic fiber has higher attenuation and hence, stronger range.

(ii) Macro bending:-

optical fiber suffer from macro-bending loss at bend 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 Microbend 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 occur during cable manufacture.

iv. Scattering:-

Rayleigh scattering sets a lower limits to the propagation losses in optical fibers. Due to the high optical intensities which often occurs in optical fiber non linear scattering processes the Roman scattering and Brillain scattering 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 absorber residual OH ⁺¹ and dopents used to modify the refractive index of the glass.

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

Sol:-

$d_0 = 50\,\mu m$

$NA = 0.0250$

$\lambda = 1330\,nm$

$N = ?$

As we know that

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

we also know that

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

$$V = 118.045 \times 0.250$$

$V = 29.51 \rightarrow$ put in (A)

$$N = \frac{(29.81)^2}{4} = \boxed{217.7}$$

Ans

(Q4) Calculate pulse spreading due to material dispersion in a single mode fiber operating at $\lambda = 1310$ nm if the LD is $\Delta\lambda = 1$ nm and $L = 1$ Km

Sol:-

we find that $D_{mat}(\lambda)$ at 1310 nm is approximately 2 ps/nm substituting the number formula

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

$$\therefore mat(\lambda) = \frac{2ps}{1nm \cdot 1km}$$

$$D_{mat}(\lambda) = \frac{2ps}{1nm\ 1km} \cdot 1nm$$

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

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

Ans.