form B [redacted] 99

Q1)

1- NoN Disperstion Shifted fiber optimized 1300 nm (1)

2- Disperstion shifted fiber

3- Disperstion flattened fiber

4- Disperstion compensating fiber

5- large effective core area fiber

Disperstion shifted fiber has zero at 1550 nm

NoN Disperstion shifted fiber has maximum attenuation

Q2) $L = 50\ km$ $\alpha = 0.5\ dB/km$

$P_{in} = 1 mW$ (1)

$P_{out} = P_{in}\ dBM - loss$

$= 25\ dB$

$P_{in}\ dBM = 10 \log\left(\frac{1 \times 10^{-3}}{10^{-6}}\right) = 30\ dBM$

$P_{out}\ dBM = 30 - 25 = 5\ dBM$

~~10 dB~~

$10 \log (P_{out} mW) = 5$

$P_{out} = 3.1 mW$

Q3)

1- ~~E~~ TE_{om} mode
2- TM_{om} mode
3- HE_{nm} mode $\quad v \geq 1$
4- EH_{nm} mode $\quad v \geq 1$

9

HE11 is the dominant mode

EH_{mm} mean $E_z > H_z$ (Amplitude) in Amplitude

Electric wave Amplitude > magnetic wave

Q4) $n_1 = 1.46 \quad \Delta = 0.25\%$
wanted maximum a
$V = 2.405$
$\lambda = 1300 nm$

$$V = \frac{2 \pi a}{\lambda} NA$$

10

$NA = n_1 \sqrt{2\Delta} = 1.46 \times \sqrt{2 \times .25\%} = 0.103$

$2.405 = \frac{2 \pi a \times 0.103}{1300 \times 10^{-9}} \Rightarrow a = \frac{2.405 \times 1300 \times 10^{-9}}{2 \pi \times 0.103}$

$a = 4.88\,\mu m$

$$V = \frac{2\pi a}{\lambda} NA$$

for $\lambda = 1550$

$V = 2.0171 < 2.405$ yes it can use

for $\lambda = 850$ nm

$V = 3.67 > 2.405$

it can't support this wave at $\lambda = 850$ nm

---

wave

Q5) 1- Single mode fiber
advantege 1- highes bandwidth dis adva

Type	Advantege	dis advante
single ~~mode~~ fiber step index	Highest Bandwidth	highest cost
multi-mode step index	lowest ~~Highest~~ splicing loss	the lowest Band...
multimode graded index	Highest power avalanghe	low in Bandw... with respect to single mo...

$n_1 = 1.48$ $n_2 = 1.46$ $\lambda = 1300\,nm$

wanted θ_c , NA , $\theta_{0\,max}$, Δ , M

1- $\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right) = 80.57^{\circ}$

2- $NA = \sqrt{n_1^2 - n_2^2} = 0.2425$

3- $\sin\theta_{0\,max} = \sqrt{n_1^2 - n_2^2}$

$\theta_{0\,max} = \sin^{-1}(NA) = 14^{\circ}$

4- $\Delta = \frac{n_1 - n_2}{n_1} = 0.0135$

5- $M = \frac{V^2}{2} = \frac{\left(\frac{2\pi a}{\lambda} NA\right)^2}{2}$

$V = \frac{2\pi a NA}{\lambda} = \frac{2\pi \times 25 \times 10^{-6} \times 0.2425}{1300 \times 10^{-9}}$

$= 29.3$

M = 429.3 modes

form B   محمد محمود
20070021078

Q7)

1- ~~Chromatic~~ dispertion
2- modal dispertion
3- polarization dispertion

10

largest one is the modal dispersion

the ~~lowest one~~ smallest one is the polarization dispertion

---

Q8) preform:

D = 10mm   L = 100cm

fiber diameter d = 125 μm

10

from the conservation of mass

Volume of preform = Volume of fiber

$$\pi\left(\frac{D}{2}\right)^2 L = \pi\left(\frac{d}{2}\right)^2 L$$

$$\left(5\times10^{-3}\right)^2 \times 100\times10^{-2} = \left(\frac{125\times10^{-6}}{2}\right)^2 \times L$$

$$\boxed{L = 6400\ m}$$

9-)

1- it's able to make thin, flexible long ~~optical~~ optical wire

(1)

2- ~~it's~~ it's transparent for a particular optical ~~fiber~~ wavelength

the three are

1- outside vabor deposition

2- Vabor axial deposition

3- modified chemical Vabor deposition

Q10) $L = 50 km$ single mode

$n_1 = 1.48$ $\Delta = 0.005$

$D_{mat} = 5 ps/(km\,nm)$

$[Vd^2 Vb/dV^2] = 0.5$ $\Delta\lambda = 2 nm$

$\lambda = 1550 nm$

wanted the chromatic dispertion

$\sigma_{mat} = D_{mat} L \sigma_\lambda$

$= 5 * 50 * 2 = 500\ ps$

$\sigma_{wg} = D_{wg} L \sigma_\lambda$

$D_{wg} = -\frac{n_2 \Delta}{\lambda c}\left[V \frac{d^2(Vb)}{dV^2} \right]$

10

~~$n_2 =$~~

$\Delta = \frac{n_1 - n_2}{n_1} \Rightarrow n_2 = 1.4726$

$D_{wg} = -\frac{1.4726 * 0.065}{1550 (nm) * 3*10^5 (km)} [0.5]$

$D_{wg} =$ ~~-15.83~~ $-7.917\ ps/(nm.km)$

$\sigma_{wg} = \frac{-15.83}{2} * 50 * 2 =$ ~~1583 ps~~ $-791.7\ ps$

$\sigma_{chro} = \sigma_{wg} + \sigma_{mat} =$

= ~~1083 ps~~ $= 291.7\ ps$

$1/\sigma_{chro}$

$B_T = 1/...$ ~~9234 MHz~~ $3.4\ GH$...

Band width product = 50 * ~~923.360 MHz~~ 3.43 GHZ

= ~~46163 MHZ.km~~

= ~~46 GHZ.km~~

= 171.41 GHZ.km