STEP INDEX FIBER

1. The refractive index of the core is uniform throughout and undergoes on abrupt change at the core cladding boundary.

2. The diameter of the core is about 50-200μm in the case of multimode fiber and 10μm in the case of single mode fiber.

3. The path of light propagation is zig- zag in manner.

3. Attenuation is more for multimode step index fiber but for single mode it is very less.

Explanation:

When a ray travels through the longer distances there will be some difference in reflected angles. Hence high angle rays arrive later than low angle rays causing dispersion resulting in distorted output.

4. This fiber has lower bandwidth.

5. The light ray propagation is in the form of meridional rays and it passes through the fiber axis.

GRADED INDEX FIBER

1. The refractive index of the core is made to vary gradually such that it is maximum at the center of the core.

2. The diameter of the core is about 50μm in the case of multimode fiber.

3. The path of light is helical in manner.

3. Attenuation is less.

Explanation:

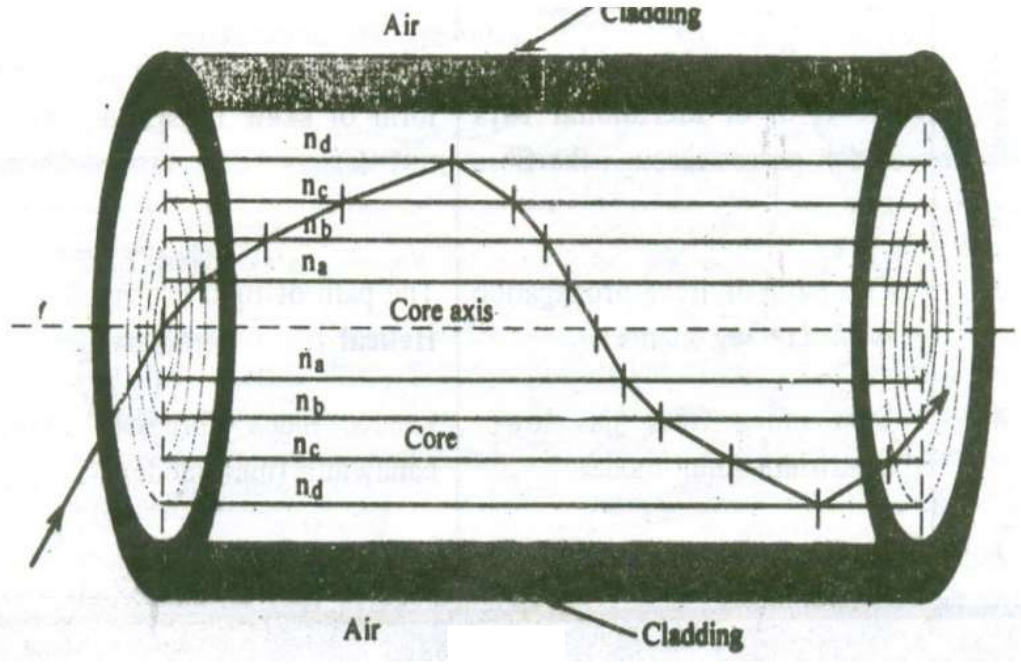
Here the light rays travel with different velocity inn different paths because of their variation in their refractive indices. At the outer edge it travels faster than near the center. But almost all the rays reach the exit at the same time due to helical path. Thus, there is no dispersion.

4. This fiber has higher bandwidth.

5. The light propagation is in the form of skew rays and it will not cross fiber axis.

PROPAGATION OF LIGHT IN FIBER

Let na, nb,nc,nd etc be the refractive index of different layers in graded index fiber with na > nb> nc> nd etc. then the propagation of light through the graded index fiber is as shown in the figure.



Here, since na > nb the ray gets refracted. Similarly since nb> nc, the ray gets refracted and so on. In a similar manner, due to decrease in refractive index the ray gets gradually curved towards the upward direction and at one place , where in it satisfies the condition for total internal reflection,($\phi > \phi c$) it is totally internally reflected .

The reflected rays travels back towards the core axis and without crossing the fiber axis, it is refracted towards downwards direction and again gets totally internally reflected and passes towards upward direction.

Difference between Step Index fiber and Graded Index fiber

S. NO	STEP INDEX FIBER	GRADED INDEX FIBER
1.	The refractive index of the core is uniform throughout and undergoes on abrupt change at the core cladding boundary	The refractive index of the core is made to vary gradually such that it is maximum at the center of the core.
2.	The diameter of the core is about 50-200μm in the case of multimode fiber and 10μm in the case of single mode fiber	The diameter of the core is about 50μm in the case of multimode fiber
3.	The path of light propagation is ***zig- zag*** in manner	The path of light is ***helical*** in manner
3.	***Attenuation is more*** for multimode step index fiber but for single mode it is very less. *Explanation:* When a ray travels through the longer distances there will be some difference in reflected angles. Hence high angle rays arrive later than low angle rays causing dispersion resulting in distorted output.	***Attenuation is less.*** *Explanation:* Here the light rays travel with different velocity inn different paths because of their variation in their refractive indices. At the outer edge it travels faster than near the center. But almost all the rays reach the exit at the same time due to helical path. Thus, there is no dispersion.
4.	This fiber has ***lower bandwidth***	This fiber has ***higher bandwidth***
5.	The light ray propagation is in the form of meridional rays and it passes through the fiber axis.	The light propagation is in the form of skew rays and it will not cross fiber axis.
6.	**No of modes of Propagation:** $N_{step} = 4.9\left(\frac{d \times NA}{\lambda}\right)^2 = \frac{V^2}{2}$ Where d= diameter of the fiber core λ= wavelength NA = Numerical Aperture V- V-number is less than or equal to 2.405 for single mode fibers and greater than 2.405 for multimode fibers.	**No of modes of Propagation:** $N_{Graded} = \frac{4.9\left(\frac{d \times NA}{\lambda}\right)^2}{2} = \frac{v^2}{4}$ Or $N_{graded} = \frac{N_{step}}{2}$