## 2.1 ATTENUATION

- **Attenuation** is a measure of decay of signal strength or loss of light power that occurs as light pulses propagate through the length of the fiber.
- In optical fibers the attenuation is mainly caused by two physical factors absorption and scattering losses.
- Absorption is because of fiber material and scattering due to structural imperfections within the fiber. Nearly 90 % of total attenuation is caused by Rayleigh scattering only. Microbending of optical fiber also contributes to the attenuation of signal.
- The rate at which light is absorbed is dependent on the wavelength of the light and the characteristics of particular glass.
- The attenuation of fiber is governed by the materials from which it is fabricated, the manufacturing process and the refractive index profile chosen. Attenuation loss is measured in dB/km.

### Sources of Attenuation

1. Material absorption.
2. Bending loss.
3. Dispersion.
4. Leaky modes.
5. Scattering losses.
6. Core and cladding loss.
7. Mode coupling.
8. Pulse broadening.

### Attenuation Units

- As attenuation leads to a loss of power along the fiber, the output power is significantly less than the coupled power. Let the coupled optical power is P(0) i.e. at origin (z = 0).
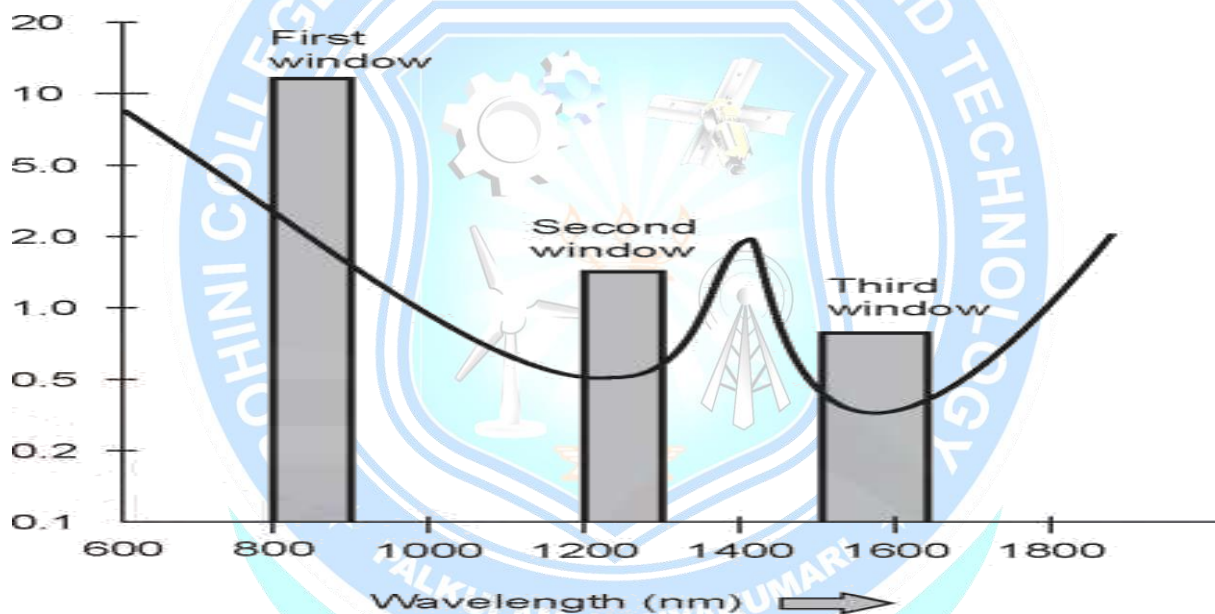- Then the power at distance z is given by,

$$P(Z) = P(0)e^{-\alpha_p.z}$$

Where, $\alpha_p$ is fiber attenuation constant (per KM)

$$\alpha_p = \frac{1}{z}\ln\left[\frac{p(0)}{p(z)}\right]$$

EC8751 optical Communication

$$\alpha_{(\frac{dB}{km})} = 10 \; \frac{1}{z} log \left[ \frac{p(0)}{p(z)} \right]$$

$$\alpha_{(\frac{dB}{km})} = 4.343 \; \alpha_{p} \text{ per km}$$

- This parameter is known as **fiber loss** or **fiber attenuation.**
- Attenuation is also a function of wavelength. Optical fiber wavelength as a function of wavelength is shown in Fig