Unit-2

Lecture -1

Attenuation

Signal Attenuation & Distortion in Optical Fibers

- What are the loss or signal attenuation mechanism in a fiber?
- Why & to what degree do optical signals get distorted as they propagate down a fiber?
- Signal attenuation (fiber loss) largely determines the maximum repeaterless separation between optical transmitter & receiver.
- Signal distortion cause that optical pulses to broaden as they travel along a fiber, the overlap between neighboring pulses, creating errors in the receiver output, resulting in the limitation of information-carrying capacity of a fiber.

Attenuation

- The signal attenuation within the optical fibers, is usually expressed in logarithmic unit of the decibel.
- The decibel is usually used to compare two power levels.
- It is defined as the ratio of input power (transmitted)to the output power (received).

Attenuation (fiber loss)

• Power loss along a fiber:



$$P(z) = P(0)e^{-\alpha_p z}$$
^[3-1]

• The parameter α_p is called fiber attenuation coefficient in a units of for example [1/km] or [nepers/km]. A more common unit is [dB/km] that is defined by:

$$\alpha [dB/km] = \frac{10}{l} \log \left[\frac{P(0)}{P(l)} \right] = 4.343 \alpha_p [1/km]$$
 [3-2]

Attenuation factors

- Absorption
- Scattering losses
- Bending losses
- Core and cladding losses

Fiber loss in dB/km



$P(l)[dBm] = P(0)[dBm] - \alpha[dB/km] \times l[km]$ ^[3-3]

• Where [dBm] or dB milliwat is 10log(*P* [mW]).

Optical fiber attenuation vs. wavelength

