UNIT – II WAVES AND OPTICS

TOPIC – VIII DISPERSION AND COMMUNICATION

5.25 DISTORTION AND DISPERSION

The optical signal becomes increasingly distorted as it travels along a fiber. This distortion is due to dispersion effect.

Dispersion

When an optical signal (or) pulse is sent into the fiber the pulse spreads/broaden as it propagates through the fiber. This phenomenon is called dispersion as shown in figure 5.33. We can see that the pulse received at the output is wider than the input pulse. Hence the output pulse is said to be distorted, due to dispersion effect.

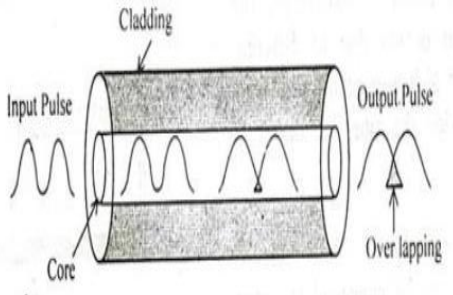

Fig.5.33

The pulse broadening (or) dispersion will occur in three ways, viz.,

(1) Inter-modal dispersion

(2) Material dispersion (or) chromatic dispersion and

(3) Waveguide dispersion.

Inter-modal dispersion

When more than one mode is propagating through a fiber, then the inter modal dispersion will occur. Since, many modes are propagating; they will have different wavelengths and will take different time to propagate through the fiber, which leads to inter-modal dispersion.

Explanation:

When a ray of light is launched into the fiber, the pulse is dispersed in all possible paths through the core, so called different modes. Each mode will be of different wavelength and has different velocity as shown in fig.5.34. Hence, they reach the end of the fiber at different time, this result in the elongation (or) stretching of data in the pulse. Thus causes the distorted pulse. This is known as inter-modal dispersion.

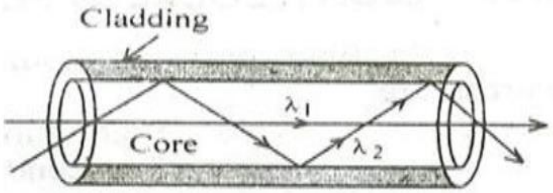

Fig.5.34

Material dispersion/Chromatic dispersion

In material dispersion, the dispersion occurs due to different wavelength of light travelling at different speed inside the fiber as shown in fig 5.35.

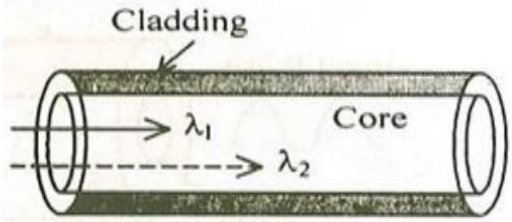

Fig.5.35

Remedy

The material dispersion can be minimized at certain wavelengths say 870 nm, 1300 nm and as **Zero Dispersion wavelengths (ZDW)**.

i.e., when the light wavelength is lesser than the zero dispersion wavelength (ZDW) it travels slower and when it is higher than (ZDW) it travels faster. Thus the speed is altered and adjusted in such a way that all the waves passing through the fiber will move with constant speed and hence the material dispersion is minimized.

Wave guide dispersion

The wave guide dispersion arises due to the guiding property of the fiber and due to their different angles at which they incident at the core-cladding interface of the fiber, as shown in fig 5.36.

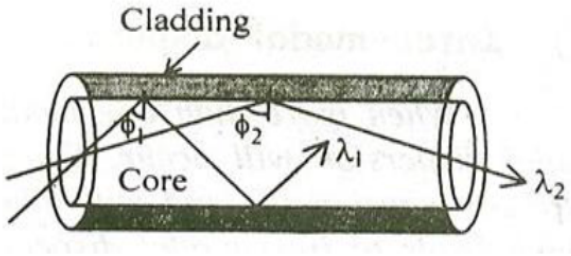

Fig.5.36

In general,

Inter-modal dispersion >Material dispersion>Waveguide dispersion

5.26 FIBER OPTICAL COMMUNICATION SYSTEM

An optical fiber communication System (Block diagram) consists of three important parts viz., (i) Transmitter (ii) Optical fiber (iii) Receiver as shown in fig 5.37.

(a) Information signal source:

The information signal source may be voice, music, video signals etc. Which is in the analog form to be transmitted is converted from Analog signal to electrical signal.

(b) Transmitter:

The transmitter consists of a drive circuit and a light source. The drive circuit transfers the electric input signal into digital pulses and the light source coverts that into optical pulses. The source usually used in LED. Here the electric pulses modulate the intensity of light source (Laser (or) LED) and are focused onto the optical fiber.

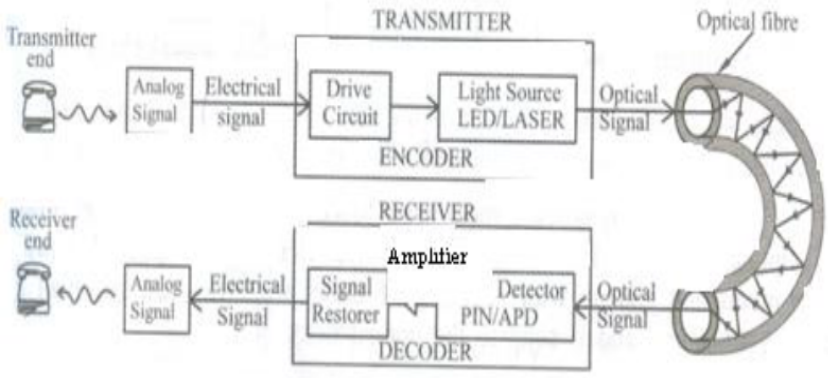

Fig.5.37

(c) Optical fiber

It acts as a waveguide and transmits the optical pulses towards the receiver, by the principle of total internal reflection.

(d) Receiver

The photo detector is a receiver which receives the optical pulses and converts it into electrical pulses. Further the signals are amplified by an amplifier. These electrical signals are decoded (i.e.) converted from digital to Analog signals. Thus the original electrical signal is obtained, in analog form, with the same information. In this way information is transmitted from one end to other end.