Assisgnment-9 Experiment-9

STUDY OF ATTENUATION AND PROPAGATION CHARACTERISTICS OF OPTICAL FIBER CABLE

I . ATTENUATION IN FIBERS

Aim

(i) To determine the attenuation for the given optical fiber.

(ii) To measure the numerical aperture and hence the acceptance angle of the given fiber cables.

Apparatus Required

Fiber optic light source, optic power meter and fiber cables (1m and 5m), Numerical aperture measurement JIG, optical fiber cable with source, screen.

Principle

The propagation of light down dielectric waveguides bears some similarity to the propagation of microwaves down metal waveguides. If a beam of power P_i is launched into one end of an optical fiber and if P_f is the power remaining after a length L km has been traversed , then the attenuation is given by,

Attenuation = $10[\log (P_i/P_f)]/L$ dB /km

Formula

Attenuation = $10[\log (P_i/P_f)]/L$ dB /km

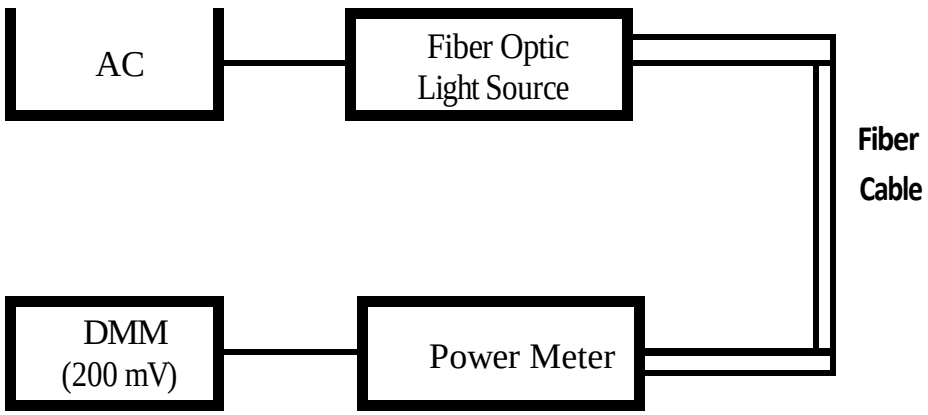

Fig.5.1 Setup for loss measurement

Table 9.1: Determination of Attenuation for optical fiber cables

$L = 4\ m = 4 \times 10^{-3}$ km

Source Level	Power output for 1m cable (P_i)	Power output for 5m cable (P_f)	**Attenuation=** $10[\log (P_i/P_f)]/L$ dB /km
Min	-27.8	-27.2	
Max	-14.2	-12.9	

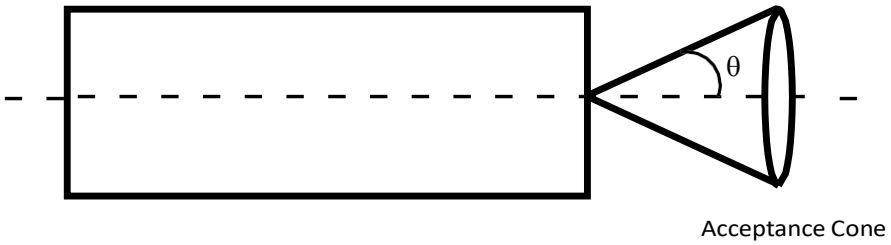

Fig. 5.2. Numerical Aperture

Table 9.2: Measurement of Numerical Aperture

Circle	Distance between source and screen (L) (mm)	Diameter of the spot W (mm)	$NA = \frac{W}{\sqrt{4L^2 + W^2}}$	θ
5m	10	10		
	12	12		
	14	14		
	16	17		
	18	19		
1m	10	11		
	12	12		
	14	15		
	16	18		
	18	19		

Result I

1. Attenuation at source level A = ---------- (dB/km)
2. Attenuation at source level B = ----------(dB/km)

II. Numerical Aperture

Principle

Numerical aperture refers to the maximum angle at which the light incident on the fiber end is totally internally reflected and transmitted properly along the fiber. The cone formed by the rotation of this angle along the axis of the fiber is the cone of acceptance of the fiber.

Formula

$$\text{Numerical aperture (NA)} = \frac{W}{\sqrt{4L^2 + W^2}} = \sin\theta_{max}$$

Acceptance angle = $2\,\theta_{max}$ (deg)

where L = distance of the screen from the fiber end in metre

W =diameter of the spot in metre.

Result II

i) The numerical aperture of fiber is measured as 5m= ---- , 1m= --------

ii) The acceptance angle is calculated as 5m = ---------, 1m = ----------

Assignment Question:

1. By using the readings in the tabular column 9.1 and 9.2 calculate the attenuation, numerical aperture and acceptance angle.
2. Enter the values in the tabular column in your observation note book.
2. Write the result in the following order

Result I

1. Attenuation at source level A = ---------- (dB/km)
2. Attenuation at source level B = ----------(dB/km)

Result II

i) The numerical aperture of fiber is measured as 5m = ---- , 1m = --------

ii) The acceptance angle is calculated as 5m = ---------, 1m = ----------

Finally, submit the scanned copy of your observation note book in GCR on (or) before THREE working days from the date of experiment