Experiment -07:

Aim:

To determine Numerical Aperture (NA) & acceptable angle (θ) of given 2 different (1m & 0.5m) cables - optical fibres to find their suitability in ~~test~~ tele communications applications.

Observing the optical power losses when light is passing through a different (1 & 0.5m) cables - optical fibres during (a) when they are not copled each other & (b) when they are coupled with each other through adaptor

Apparatus Required:

Fiber optic (?), light source, fiber optic power meter, fiber optic (FO) cable - 1m & 0.5m, In line adapter, NA - Jig IL - slope with scale one one side and connector on the other

Formula:

$$NA = \sin a = \frac{\omega}{\sqrt{4L^2 + \omega^2}}$$

w = diameter of spot (m).
L = Distance of bet. fiber and & screen (m)
a = acceptance angle (θ).

Procedure:

Determining NA & a;

1. Connect one end of 1m FO cable and other end to NA Jig as shown in figure.

2. Plug in the main, light should appear at the end of the fiber on NA jig.

3. Notice the horizontally movable acrylic screen - printed plate attached with NA jig. This screen is drawn with concentric circles of 10, 15, 20, 25 & 30 mm diameters.

4. Now move the acrylic screen-printed plate to a distance L (say 1mm) from the fiber end, view the spot and measure its diameter W.

5. Repeat for different L values. Note diameter (W) for each.

6. Calculate NA using above relations.

7. Now fix 0.5m cable & repeat process.

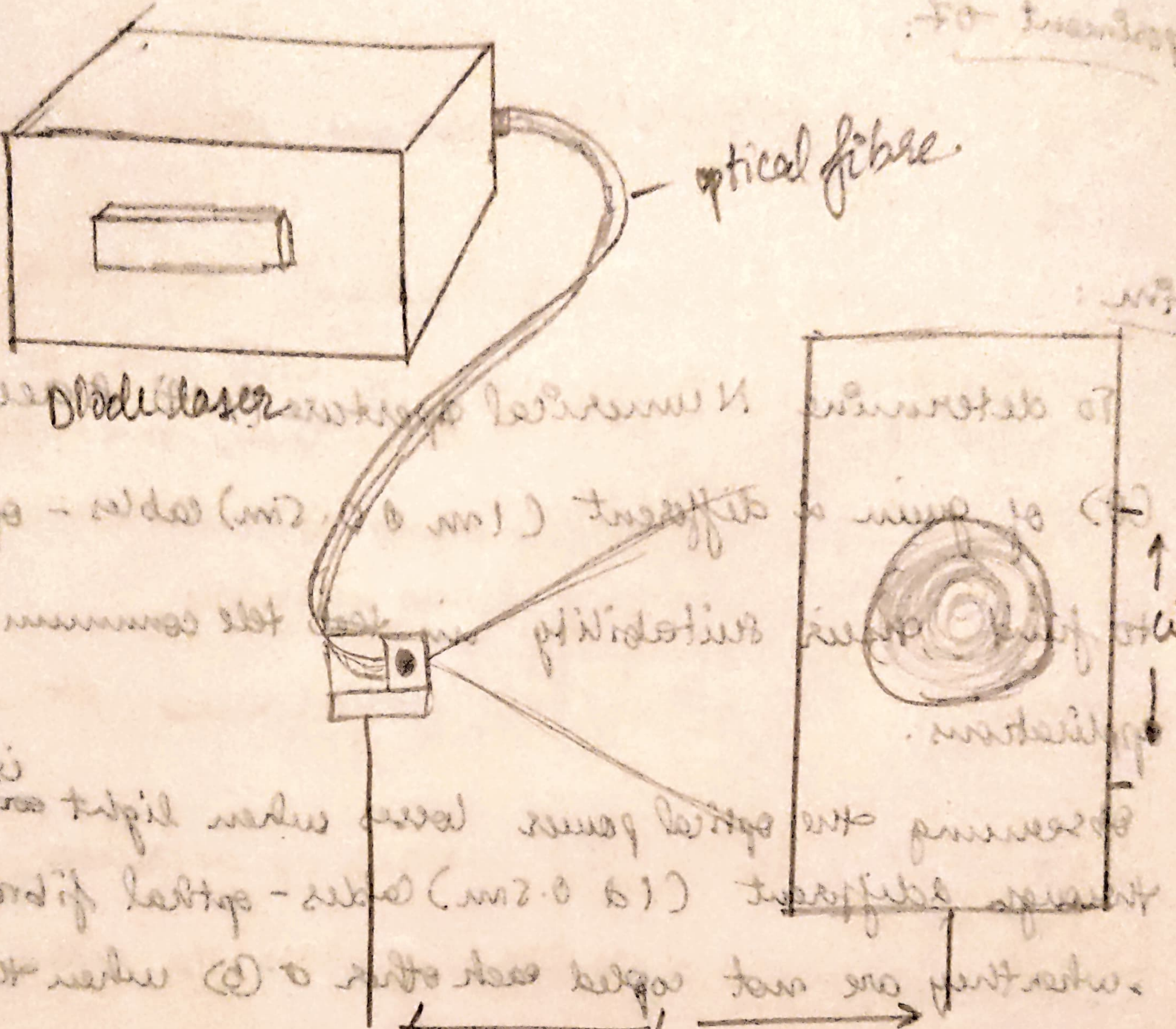
<u>Optical power:</u>

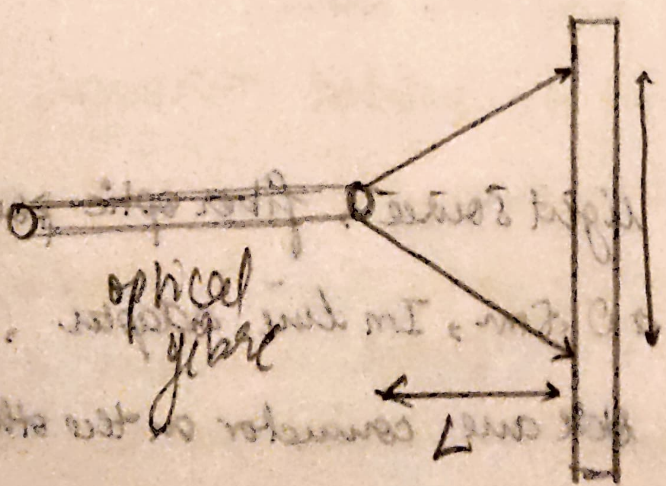
1. Connect one end of 1m FO cable to FO LED and other end to fiber optic power & observe displayed value & estimate power loss.

2. Connect 0.5 m FO cable to FO LED and repeat same.

3. Connect both FO fiber optics through the given in-line adaptor and connect one end of this coupled FO cables to the FO LED and the other end to the fiber optic power & observe the displayed value & estimate power loss.

4. Estimate power loss in all above cases.


optical fibre
Diode laser
W
L


W
optical fibre
L

For length = 0.5 m :

S.no.	L (mm)	W (mm)	NA (no)	a (deg).
1.	22	30	0.56	34.28
2.	20	25	0.53	32
3.	14	20	0.58	35.55
4.	12	15	0.53	32.0
5.	4	10	0.78	51.3

P loss: -37.9db

mean (NA) = 0.596

mean (a) = 37.02°

For length = 1m :

S.no.	L (mm)	W (mm)	NA (no)	a (deg).
1.	23	30	0.55	33.11
2	18	25	0.57	34.7
3.	14	20	0.58	35.5
4.	12	15	0.53	32
5.	6	10.	0.64	39.81

P.loss :- 57.4dB.

mean (NA) = 0.574

mean (a) = 35.024°

Calculations:

Table 1:- For: 0.5mm :

1. $NA = \sin a = \dfrac{w}{\sqrt{4L^2+w^2}} = \dfrac{30}{\sqrt{4(22)^2+30^2}} = 0.56.$

$a = \cancel{33.09}\ 34.28°$

2. $NA = \sin a = \dfrac{25}{\sqrt{4(20)^2+25^2}} = 0.53$

$a = 32°$

3. $NA = \sin a = \dfrac{20}{\sqrt{4(14)^2+20^2}} = 0.58$

$a = 35.54°$

4. $NA = \sin a = \dfrac{15}{\sqrt{4(12)^2+15^2}} = 0.53$

$a = 32°$

5. $NA = \sin a = \dfrac{10}{\sqrt{4(4)^2 + 10^2}} = 0.78$

$a = 51.3°$

Table 2:- $f_0 = 1m$;

1. $NA = \sin a = \dfrac{30}{\sqrt{4(23)^2 + 30^2}} = 0.546$

$a = 33.11°$

2. $NA = \sin a = \dfrac{25}{\sqrt{4(18)^2 + 25^2}} = 0.57$

$a = 34.7°$

3. $NA = \sin a = \dfrac{20}{\sqrt{4(14)^2 + 20^2}} = 0.58$

$a = 35.5°$

4. $NA = \sin a = \dfrac{15}{\sqrt{4(12)^2 + 15^2}} = 0.53$

$a = 32°$

5. $NA = \sin a = \dfrac{10}{\sqrt{4(6)^2 + 10^2}} = 0.64.$

$a = 39.81°$

Results:

1) 1. NA of optical fibre - 1m = 0.574

2. acceptance angle for fibre - 0.5m = 35.024°

2) 1. NA of optical fibre - 0.5m = 0.596

2. acceptance angle for fibre - 0.5m = 37.03°

3) 1. Power loss when ~~light pass~~ light passes through optical fibre - 1m = -57.4dB

2. Power loss when light passes through optical fibre (0.5m) = -37.9dB

3. Power loss when light passes through (1 & 0.5m) cables when they are coupled through inline adapter = 47.65dB