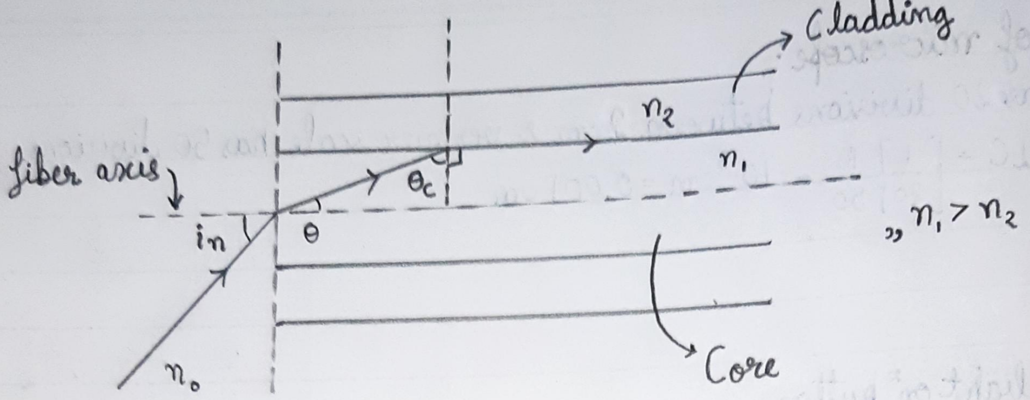


Observations:

S.no.	Screw Gauge		Distance, X (mm)	Current, I (μA)
	MSR	CSR		
1.	1	0	1.00	0
2.	1.5	0	1.50	0
3.	2	40	2.40	10^{-9}
4.	2.5	36	2.86	8.06×10^{-7}
5.	3	30	3.30	1.032×10^{-4}
6.	3.5	24	3.74	3.964×10^{-3}
7.	4	16	4.16	4.166×10^{-2}
8.	4.5	30	4.80	1.847×10^{-1}
9.	5	5	5.05	1.611×10^{-1}
10.	5.5	45	5.95	5.848×10^{-2}
11.	6	39	6.39	6.048×10^{-3}
12.	6.5	33	6.83	1.872×10^{-4}
13.	7	33	7.33	1.043×10^{-6}
14.	7.5	23	7.73	4×10^{-9}
15.	8	19	8.19	0

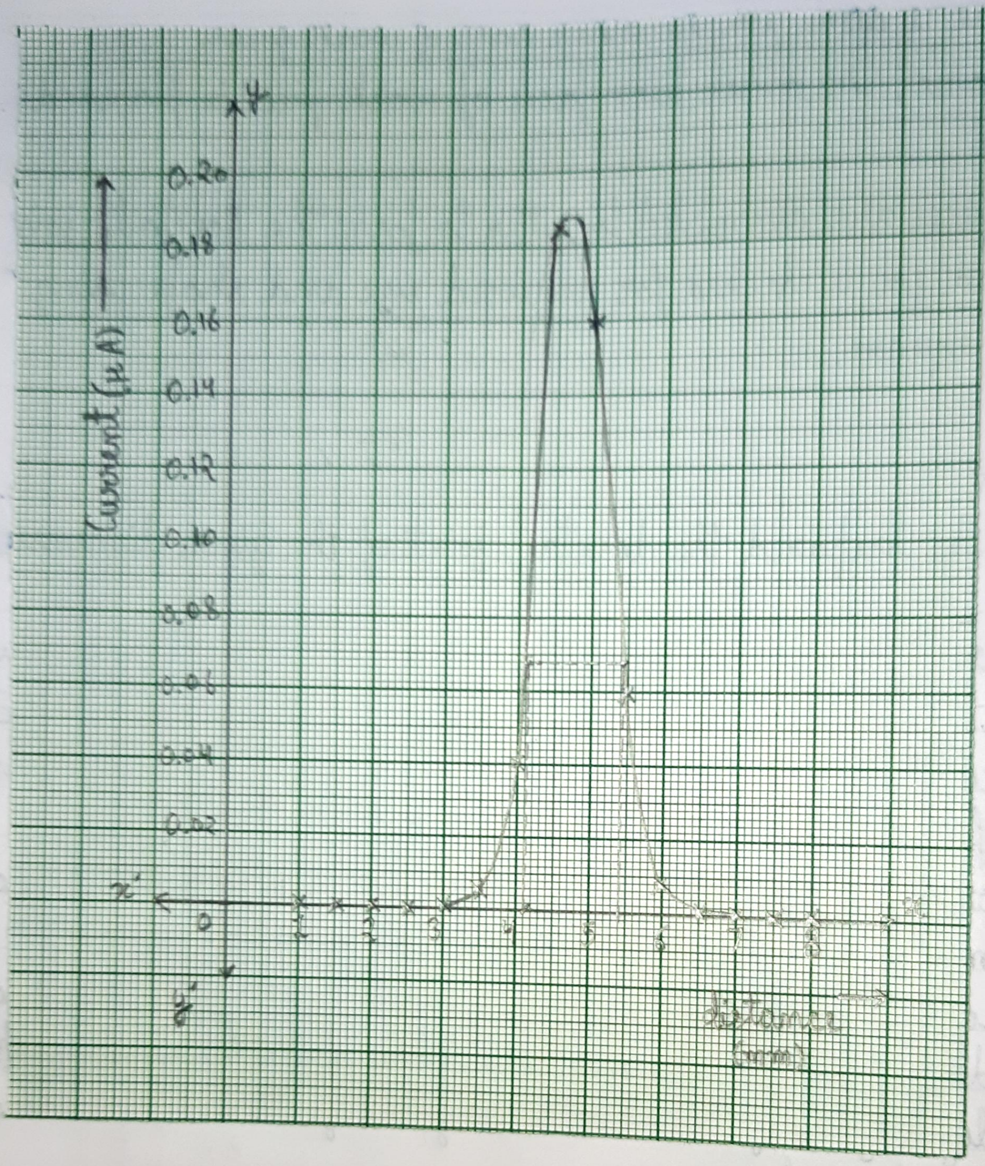
Experiment 6.

Aim:
To find the numerical aperture of a given optic fibre and hence to find its acceptance angle.

Apparatus:
Optical fibre, Output unit, Detector, Fibre stand, Concentrator, Emitter.

Theory:
Optical fibres are fine transparent glass or plastic fibers which can even propagate light. They work under the principle of total internal reflection from diametrically opposite walls. In this way light can be taken to any-where because fibers have enough flexibility.
An optic fiber consists of a core that is surrounded by a cladding which are normally made of silica glass or plastic
Consider an optical fiber having a core of refractive index n_1 and cladding of refractive index n_2. Let the incident light makes an angle i with the core axis. Then light gets refracted at an angle θ & falls on the core cladding interface at an angle θ' where,
$\theta' = 90 - \theta$

Let the critical angle for core cladding interface be θ_c'. Using Snell's law we get,
$n_1 \sin \theta_c' = n_2 \sin 90°$
$$\sin \theta_c' = \frac{n_2}{n_1}$$



Least count of screw gauge:

$$\text{Pitch} = \frac{\text{distance}}{\text{no. of revolutions}} = \frac{1}{2}\,\text{mm}$$

$$\text{Least count, LC} = \frac{\text{pitch}}{\text{no. of div.}} = \frac{1/2}{50} = 0.01\,\text{mm}$$

Numerical Aperture is given by,

$NA = n_0 \sin i_m = n_1 \sin \theta$

$= n_1 \sin (90 - \theta_c)$

$NA = n_1 \sqrt{1 - \sin^2 \theta_c}$

as we know $\sin \theta_c = \frac{n_2}{n_1}$

$NA = \sqrt{n_1^2 - n_2^2}$

Formula used:

Numerical aperture, $NA = \sin \theta_A = \frac{r}{\sqrt{r^2 + d^2}}$

θ_A is the angle of acceptance

spot size of beam at distance d is the radius of spot ie. r.

Procedure:

1. Set the detector distance Z (say 4mm). We referred the distance as d in our all of the calculations.
2. Vary the detector distance x by an order of 0.5 mm, using screw gauge (use up & down arrows on the screw gauge to rotate it).
3. Measure the detector reading from output unit & tabulate it.
4. Plot the graph between,
   X in x axis & output reading in y axis.
5. Find the radius of the spot r, which is corresponding to $\frac{I_{max}}{2.71}$.
6. Then find numerical aperture of the optic fiber.

Calculations:

distance b/w detector & fibre, $d = 4\,mm$

$I_{max} = 0.1847\ \mu A$

$\frac{I_{max}}{2.71} = 0.069\ \mu A$

$2r = 5.43 - 4.28 = 1.15$

$r = 0.575\ mm$

Numerical aperture, $NA = \sin\theta = \frac{r}{\sqrt{r^2 + d^2}}$

$NA = \frac{0.575}{\sqrt{0.32 + 16}} \approx 0.142$

Angle of acceptance, $\theta = \sin^{-1}(NA)$

$= \sin^{-1}(0.142)$

$\simeq 8.163^\circ$

Results:

Numerical aperture of optical fiber is 0.142.
Angle of acceptance is 8.163°

Precautions and Sources of errors:

1. Optical fiber cable should be free from any twists or folds.
2. Parallax error must be avoided.
3. Readings should be takan carefully.
4. Connections must be proper & tight.