Roll No. 41 CLASS. D1AD

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

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CERTIFICATE

Certified that Mr./Miss Yash Sarang of FE Branch AIDS has satisfactorily completed a course of the necessary experiments in Engineering Physics Sem ~~I~~/II under my supervision in the Institute of Technology in the year 2020-2021.

Subject Teacher	Lab In Charge
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VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

Department of Humanities and Applied Sciences

FEC-202 **Engineering Physics – II**

Outcomes: Learner will be able to...

1) Perform the experiments based on diffraction through slits using Laser source and analyze the results.
2) Perform the experiments using optical fibre to measure numerical aperture of a given Fibre.
3) Perform the experiments on various sensors and analyze the result.

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Sr. No.	Name of Experiment	Date of preparation	Date of Submission	Co mapping	Grade	Signature
1	Sodium Light	5/7	5/7			
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4	Numerical Apperature	5/7	5/7			
5	Ultrasonic Distance	5/7	5/7			

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EXPERIMENT NO. 1

AIM: To determine the wavelength of sodium light using a diffraction grating and spectrometer

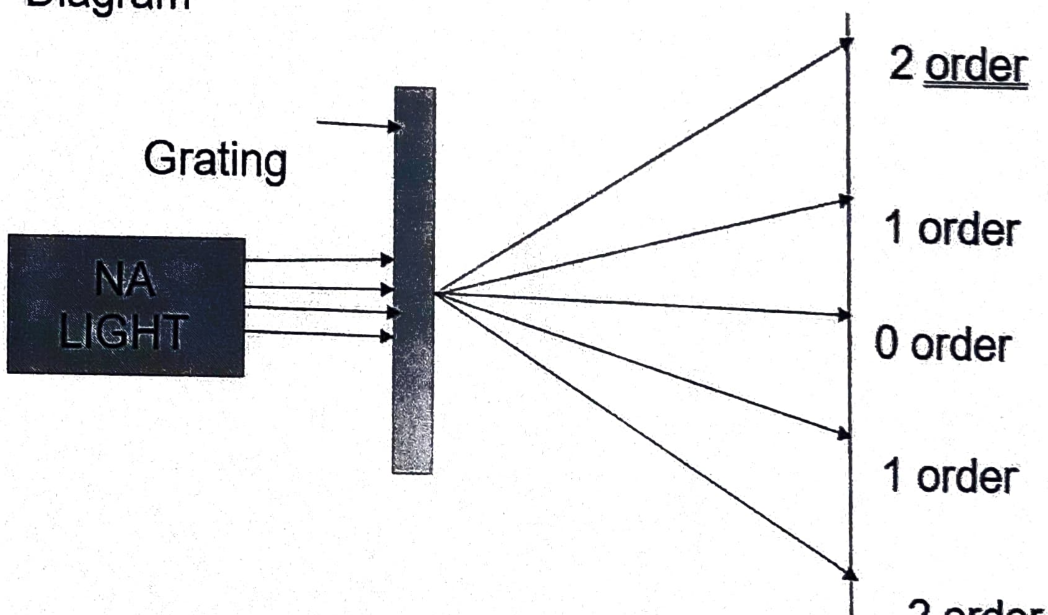
APPARATUS: Diffraction grating, spectrometer, Sodium lamp, reading lens

THEORY: A plane diffraction grating is an arrangement of a large number of identical equidistant parallel slits. When a beam of monochromatic light is incident normally on the grating surface, it gets diffracted through various angles to give a diffraction pattern made of zero order, first order, second order and higher orders depending on the grating element d, (distance between two consecutive slits) and the wavelength of light being used. The grating equation relates the grating element (d), the wavelength of incident light (λ) and the angle of diffraction (Θ) for a given order (m) and is given by

$$d \sin \Theta = m \lambda$$

DIAGRAM:

Diagram



Schematic diag. for diffraction of Na light by Grating and Spectrometer

OBSERVATION TABLE:

Grating Element (d) = (2.54/15000) cm

Order of maxima (m)	Spectrometer reading(L.H.S.) a (degrees)	Spectrometer reading (R.H.S.) b (degrees)	(a-b) = 2Θ	Angle of diffraction Θ	Calculated wavelength (λ) (Å)	Average wavelength (λ) (Å)
0	201°47′	201°47′				
1	181°16′	222°31′	41°15′	20°37.5′	5964	5974.5
2	158°1′	247°59′	89°58′	44°59′	5985	

CALCULATIONS:

d sin Θ = m λ (m=1)

$\lambda = 2.54/15000 \times \sin(20°37.5')$

$= 5964\ Å$

d sin Θ = m λ (m= 2)

$\lambda = 2.54/15000 \times \sin(44°59')$

$= 5985\ Å$

RESULT :

The Average calculated value of wavelength = 5974.5 (Å)

The standard value of wavelength = 5893 (Å)

Percentage error = 1.383%

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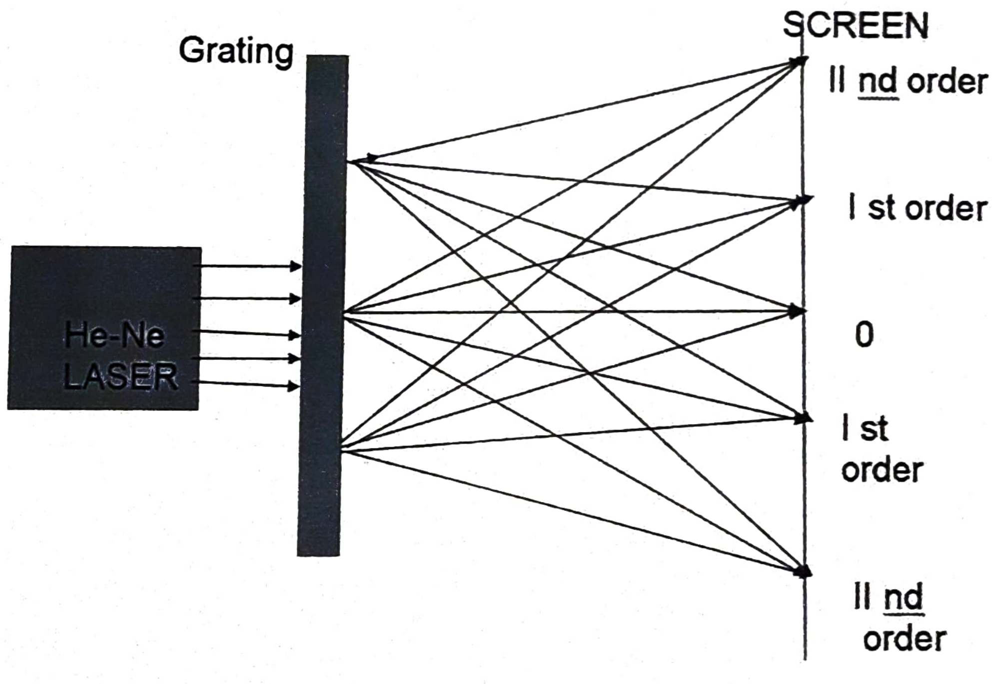
EXPERIMENT NO. 2

AIM: To determine the wavelength of the He-Ne LASER using a diffraction grating.

APPARATUS : LASER light source (He-Ne laser), diffraction grating and a meter scale

THEORY: LASER stands for Light Amplification by Stimulated Emission of Radiation. In He-Ne LASER the active medium is a mixture of He and Ne, and it is a four level laser. A grating is an arrangement of a number of identical parallel slits. When a beam of LASER light is incident normally on the surface of a grating it gets diffracted to form a diffraction pattern made of zero order, first order, second order and higher orders depending on the grating element. The angle of diffraction (Θ) or each order (m) with respect to the direction of non diffracted beam, the grating element (d) and the wavelength of incident light (λ) are related by the equation known as GRATING EQUATION, viz. $d \sin\Theta = m\lambda$

DIAGRAM:



SCHEMATIC DIAGRAM FOR He-Ne LASER DIFFRACTION THROUGH GRATING

OBSERVATION TABLE:

Grating Element (d) = 2.54/15000 cm

Sr.No.	Distance of grating from the screen D(cm)	Order of diffraction (m)	Distance between two maxima of same order (2X)	X (cm)	tanΘ= X/D
1	56.5	1	46	23	0.407
		2	132	66	1.168
2	46.5	1	40	20	0.43
		2	114	57	1.225
3	40	1	33	16.5	0.412
		2	94	47	1.175

CALCULATIONS:

Sr.No	Angle of Diffraction (Θ)	sinΘ	Wavelength λ (Å)	Mean λ(Å)
1	22.12	0.37	6381.68Å	6406.53
	48.43	0.75	6431.38Å	
2	23.26	0.39	6687.04Å	6621.71
	50.77	0.77	6558.39Å	
3	22.39	0.38	6850.54Å	6448.87
	49.60	0.76	6447.69Å	

RESULTS:

Calculated wavelength of He-Ne LASER = 6482.37 Å

Standard wavelength of He- Ne LASER = 6328 Å

Percentage Error = 2.597%

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EXPERIMENT NO. 3

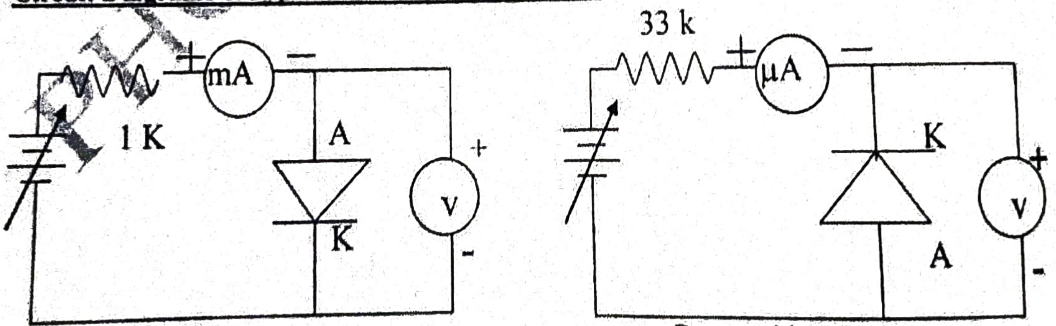
AIM: To study the V-I characteristics of a photo-diode

APPARATUS: Commercial setup with following components: Photodiode , variable light source with lamp (1to12v),Regulated power supply V (0 to 20V) with Ammeter and Voltmeter. Patch cords

THEORY: A silicon photodiode is a solid state light detector that consists of a shallow diffused P-N junction with connections provided to the outside world. When the top surface is illuminated, photons of light penetrate into the silicon to a depth determined by the photon energy and are absorbed by the silicon generating electron hole pairs. The electron-hole pairs are free to diffuse (or wander) throughout the bulk of the photodiode until they recombine. The average time before recombination is the "minority carrier lifetime". At the P-N junction is a region of strong electric field called the depletion region. It is formed by the voltage potential that exists at the P-N junction. Those light generated carriers that wander into contact with this field are swept across the junction. If an external connection is made to both sides of the junction a photo induced current will flow as long as light falls upon the photodiode. In addition to the photocurrent, a voltage is produced across the diode.

DIAGRAM:

Circuit Diagrams &Typical Characteristics Curve:



Forward bias

Reverse bias

Plot the graph .

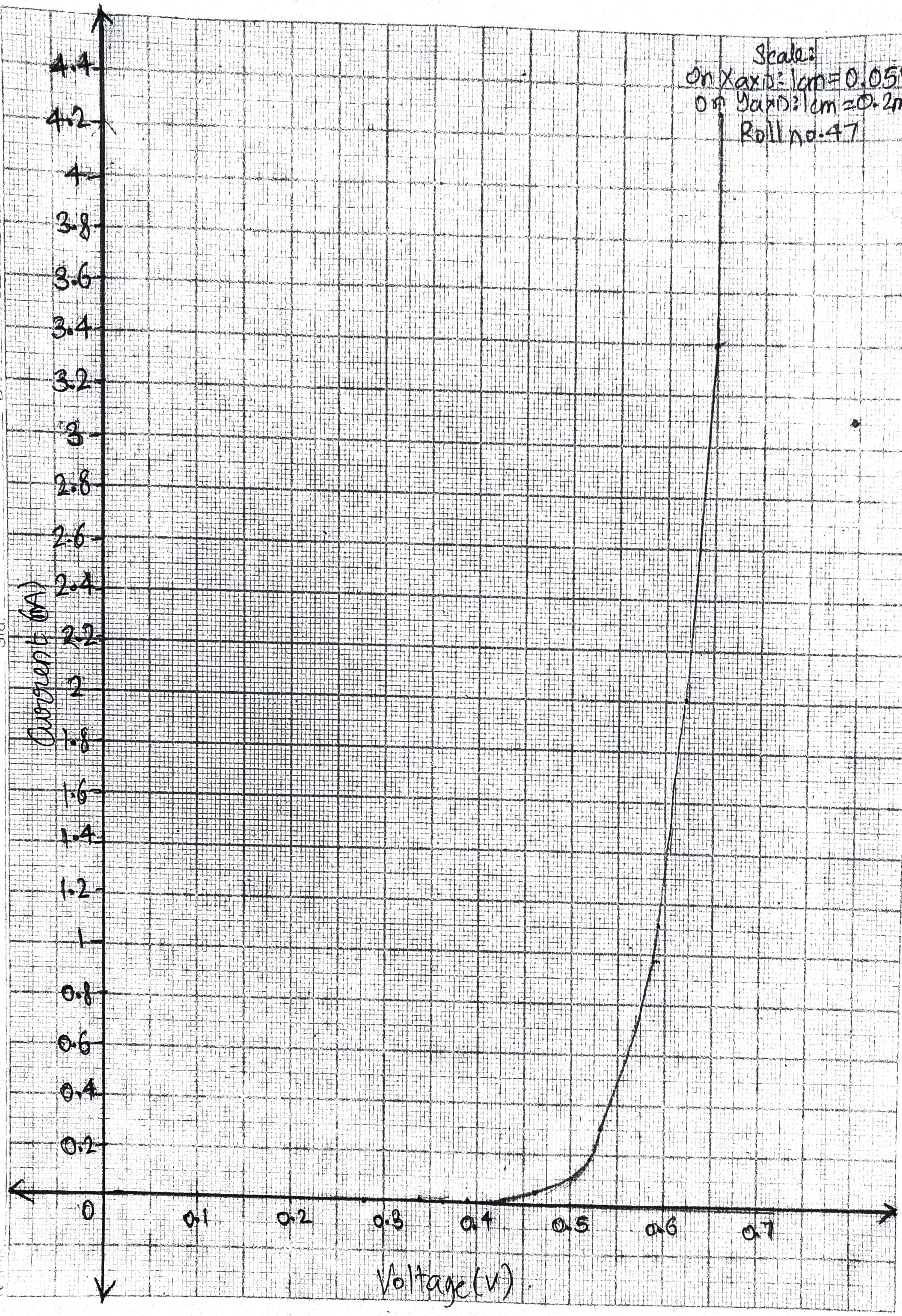
OBSERVATION TABLE:

Dark current without light= ________ mA

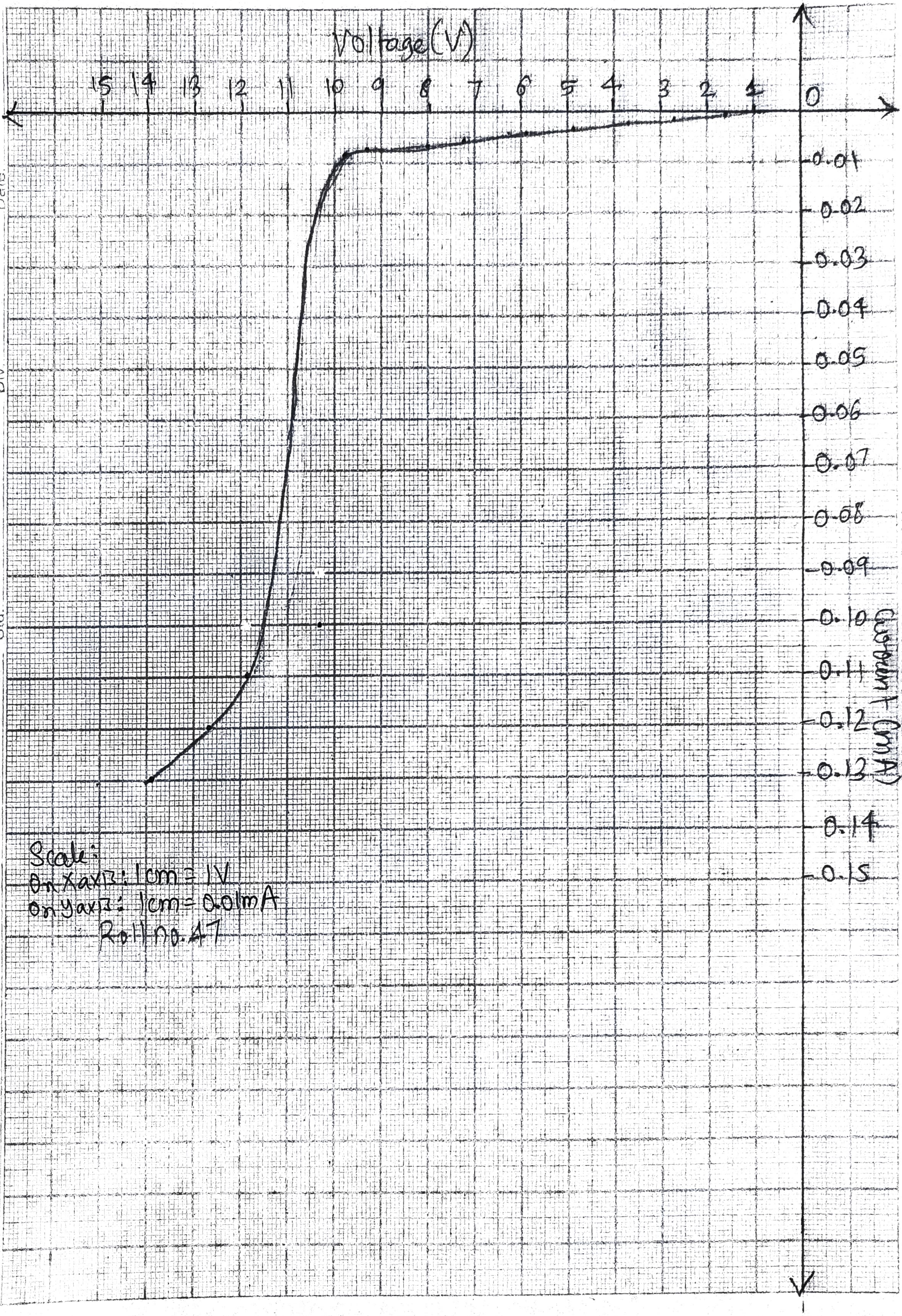
Reverse biased voltage = ________ V

Forward Bias		Reverse Bias	
V (volt)	I (mA)	V (volt)	I (mA)
0.283	0	0.90	0
0.341	0.001	1.60	0.001
0.395	0.005	2.07	0.002
0.435	0.012	3.78	0.003
0.467	0.047	4.94	0.004
0.503	0.101	5.95	0.005
0.525	0.175	7.27	0.006
0.538	0.246	8.01	0.007
0.544	0.306	9.32	0.008
0.592	0.979	9.84	0.009
Result: 0.598	1.112	10.34	0.10
0.623	2.007	11.94	0.11
0.653	3.4	12.77	0.12
0.658	4.3	13.93	0.13

Result: V-I characteristics of a photo-diode were studied.



FOR EDUCATIONAL USE ONLY


Voltage(V)
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
0.11
0.12
0.13
0.14
0.15
current (mA)
Scale:
On X axis: 1cm = 1V
on y axis: 1cm = 0.01mA
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EXPERIMENT NO. 4

AIM: To Determine Numerical Aperture of given optical Fibre.

APPARATUS: Fibre Optics, Numerical Aperture measurement kit, Patch Cords, one side connectorized fibre cable.

THEORY: Numerical Aperture is a measure of light gathering capacity of an optical fibre. If the Refractive Indices of the core and cladding of an optical fibre is n_1 and n_2 respectively. Then Numerical Aperture is defined as: $\sqrt{(n_1^2-n_2^2)}$

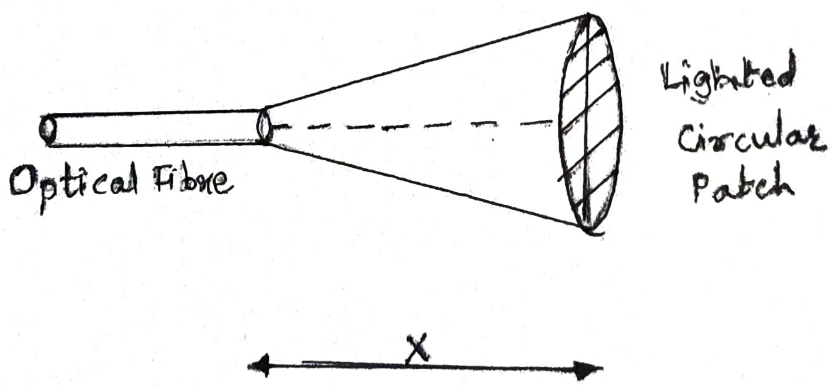
If the acceptance angle of the given fibre is θ and refractive Index of surrounding medium is n_o then

NA= $n_o \sin \theta_m$. For optical fibre in air (n_o=1) NA=$\sin\theta_m$.

If 'x' is the perpendicular distance of the tip of the fibre from the screen and 'r' is the radius of the circulator patch of the lighted portion of the screen then:

$$NA = \sin \theta m = \frac{r}{\sqrt{x^2 + r^2}}$$

DIAGRAM:



Schematic diagram for Numerical Aperature measurement of Optical Fibre

OBSERVATION TABLE:

Sr.No	X (cm)	Diameter			r (cm)	$\sin\theta m = \frac{r}{\sqrt{x^2 + r^2}}$
		D1	D2	Avg		
1	0.5	0.5	0.4	0.45	0.225	0.4104
2	1	0.9	0.8	0.85	0.425	0.3911
3	1.5	1	0.9	0.95	0.475	0.3019
4	2	1.5	1.2	~~0~~ 1.35	0.675	0.3198
5	2.5	1.5	1.5	1.5	0.75	0.2873

RESULT:

Calculated Numerical Aperture: 0.3421

Standard Value of Numerical aperture 0.2 – 0.6

Percentage Error:

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EXPERIMENT NO. 5

AIM: To determine the distance of an object using Ultrasonic Distance meter.

APPARATUS: Ultrasonic Distance meter Kit, Measuring Tape, Object(where distance is to be measured.

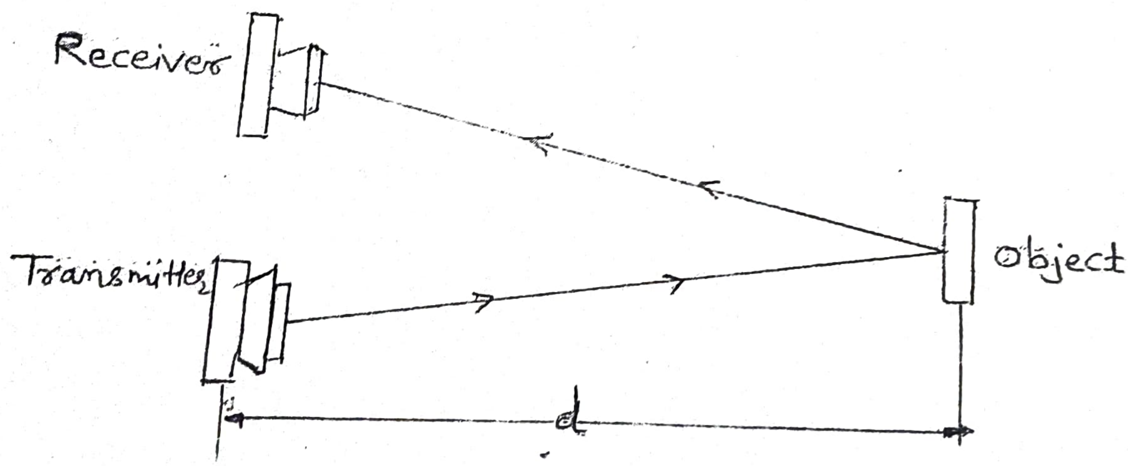
THEORY: Ultrasonic beams can be produced in the form of directed beams like beams of light. Further,they travel quite a large distance and are unidirectional. While travelling,whenever ultrasonic waves encounter an obstacle they reflect back. As a result they are used to measure distances. The source sends out short pulses of ultrasonic waves and the receiver receives the reflected waves. The distance can be calculated using the Formula $2d = V X t$

Where, d = distance between transmitter and the object

V = velocity of ultrasonic wave in air

t = time lag between sending and receiving back the signal

DIAGRAM:



Schematic diagram for measurement of Distance using Ultrasonic Distance meter.

OBSERVATION TABLE:

Sr.No	Measured Distance d (inches)	Observed Distance 2d (inches)	Calculated Distance d (inches)	Percentage Error %	Average Percentage Error %
1	32	64	32	0	
2	40	81	40.5	1.25	
3	45	91	45.5	1.11	0.856
4	50	102	51	2	
5	60	120	60	0	
6	64	129	64.5	0.78	

Calculations:

RESULT: Observed distances and measured distances are same within experimental error.