1) Aim

2) Apparatus Required

3) Formula

4) Circuit Diagram / Diagram

5) Model graph (if required)

6) Observations (Tabular columns)

7) Calculations (if required)

— 35M

8) Result — 5M

Total External = 60M = 40M + 10M + 10M

Performance and execution of output of experiment allotted to you } = 40M

Lab manual submission } = 10M

Viva-vole Marks } = 10M

60M

Use single (whole complete) page for Diagram & Tabular column

AP LAB Format for Internal & External Examination

Expt No. 1

1. Laser Diode characteristics

1) **Aim:**

To Study the V-I characteristics of Laser diode.

2) **Apparatus Required:**

Laser Diode kit
Connecting wires, Ammeter, voltmeter etc.

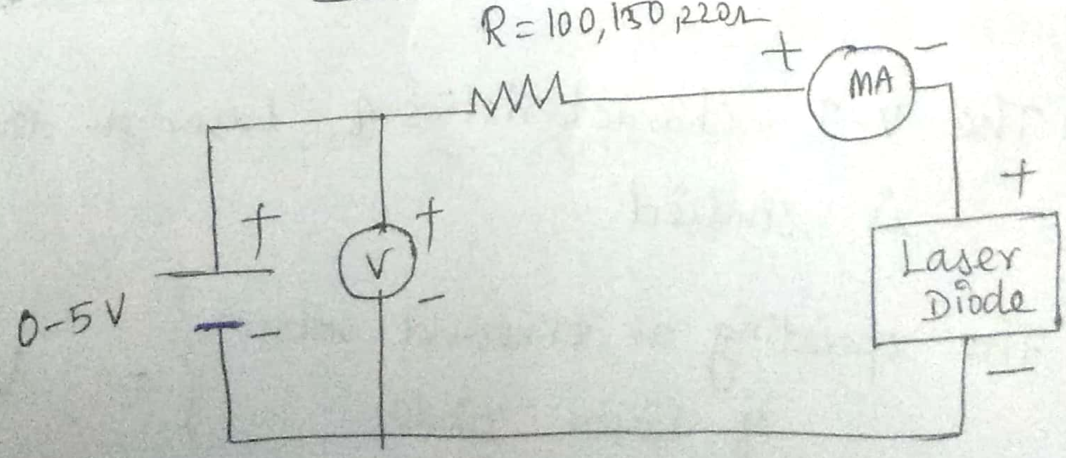
3) **Formula:**

$$\boxed{\text{Energy band gap } E_g = \frac{hc}{\lambda} \text{ eV}}$$

$$E_g = E_c - E_v$$

where, E_g - Energy band gap - eV
h - Planck's constant — J-S
λ - Wavelength of emitted radiation - A°

4) **Circuit Diagram**



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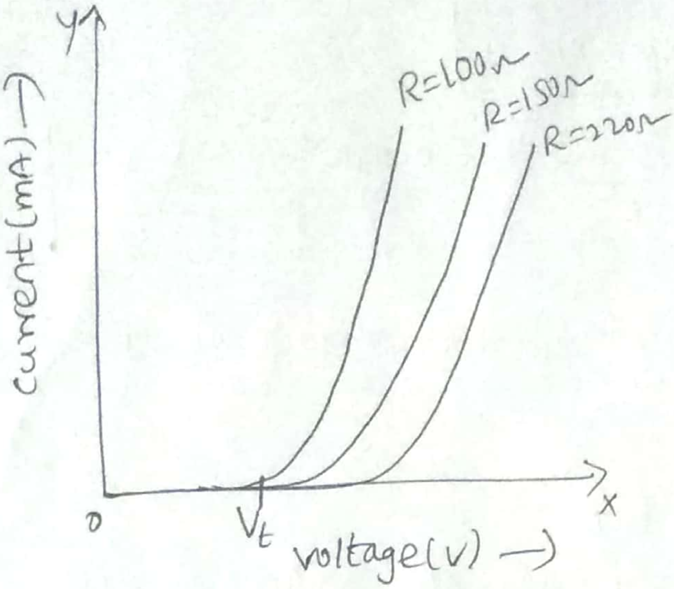
5) Model graph



6) Observations.

S.No	Voltage(V)	current (mA)		
		R=100Ω	R=150Ω	R=220Ω

7) Result:

1) The V-I characteristics of Laser ~~sto~~ diode is studied.

2) The operating or threshold voltage of Laser Diode } = ... V

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Expt. No: 2

2. Laser Diffraction grating

1. **Aim:**

To determine the wavelength of given laser source using diffraction grating.

2. **Apparatus Required:**

1) Laser source
2) Grating, meter scale etc.

3. **Formula used:**

The wavelength of given Laser source is $\left.\right\}$ $\lambda = \dfrac{\cancel{2d}\ \sin\theta}{Nn}\ \text{Å}$

where, $\sin\theta = \dfrac{x}{\sqrt{x^2+d^2}}$

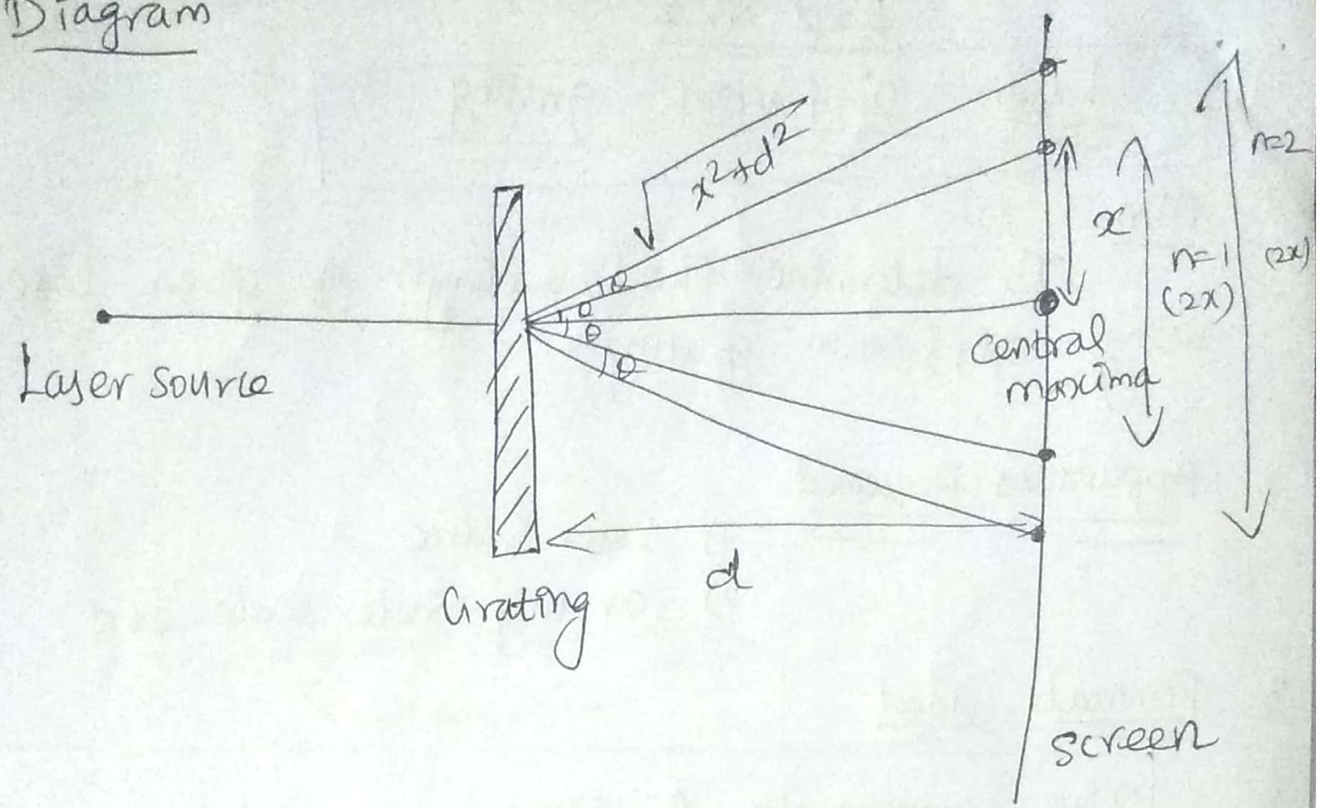
x - distance between the central maxima and different orders - cm

d - Distance between the grating and screen - cm

N - number of lines / inch in the grating [2500 lines/inch = 98425 lines/m]

n - order of diffraction

4. Diagram



5. Observations

N = 98425 lines/m

S.NO	Distance between the grating and screen d cm	order of diffraction (n)	2x cm	x cm	$\sin\theta = \frac{x}{\sqrt{x^2+d^2}}$	$\lambda = \frac{\sin\theta}{Nn}$ (A°)
1.	20	1				
		2				
2.	30	1				
		2				
3.	40	1				
		2				

Mean λ = ... A°

6. Calculation

$$\sin\theta = \frac{x}{\sqrt{x^2+d^2}} =$$

$$\lambda = \frac{\sin\theta}{Nn}\ A^\circ = \dots A^\circ$$

⋮

7. Result:

The wavelength of given Laser source $\Big\}$ $\lambda = \dots A^\circ$

Expt. No: 3

Numerical Aperture of given optical fiber

1) Aim:

To find the numerical aperture of given optical fibre.

2) Apparatus Required

1. ~~NA~~ optical fibre kit
2. NA Jig
3. NA Scale, OF cable etc..

3. Formula.

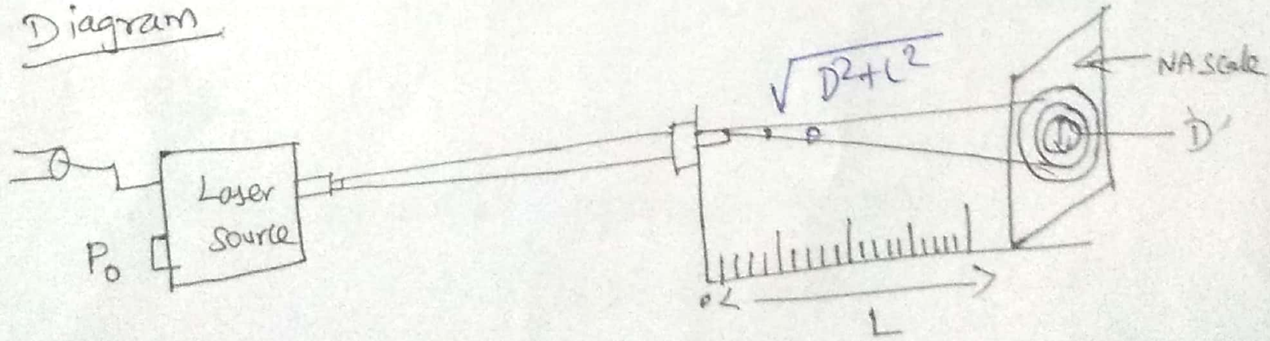
The numerical aperture of given optical fibre $\Big\}$ $NA = \dfrac{D}{\sqrt{D^2 + 4L^2}}$

Where, D – Diameter of circle in NA scale – mm

L – Distance between the light slit ~~to~~ and NA Scale

Acceptance Angle $\alpha = \sin^{-1}(NA)$

4. Diagram



NA Jig set up

Each circle diameter = 4mm

5) Observations

S No	Distance between the slit and NA Scale (L) mm	Diameter of circle (mm)	$NA = \frac{D}{\sqrt{D^2+4L^2}}$	$\alpha = \sin^{-1}(NA)$ (degree)
1.	40 10 16			

Mean NA = α = °

6) Calculations

L = 0.4 cm = 40 mm ; D = 12 mm.

$$\therefore NA = \frac{D}{\sqrt{D^2+4L^2}} = \frac{12}{\sqrt{12^2+4\times 40^2}} = \ldots$$

$$\alpha = \sin^{-1}(NA) = \sin^{-1}(\ ) = \ldots°$$

7) Result:

1) The numerical aperture of given optical fiber } NA = ...

2) The acceptance angle of given optical fiber } α = ...°

Expt. No. 4

4. Bending losses in optical fiber

1) Aim:

To find the bending losses in a given optical fibre cables

2) Apparatus Required

1) Optical fiber kit
2) OF cables of different lengths
3) Connecting wires etc..

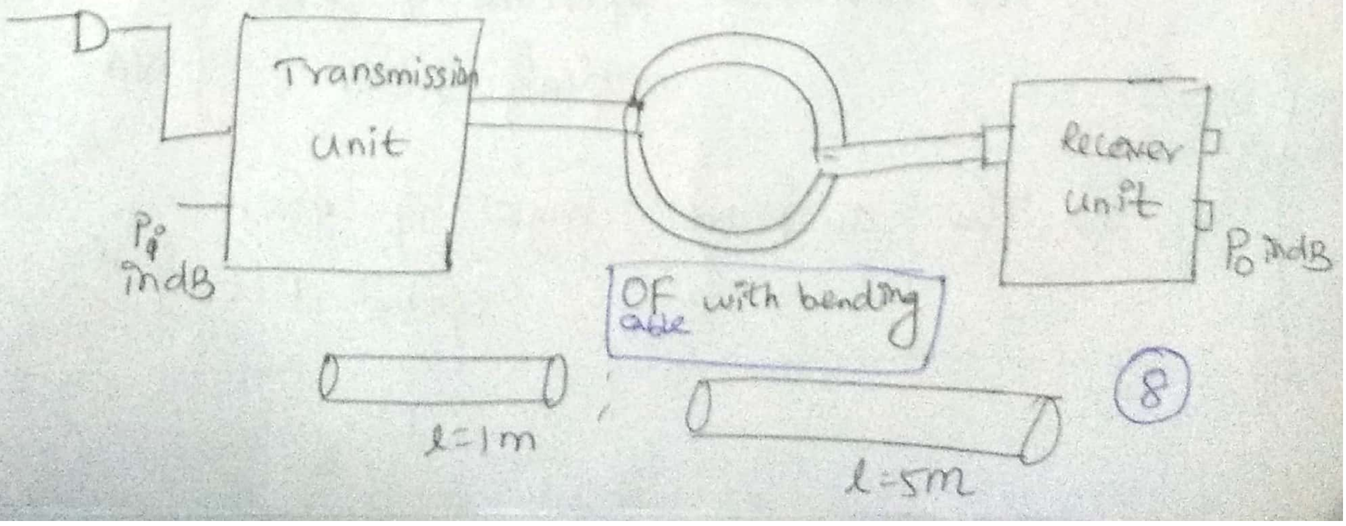
3) Formula:

The bending loss in optical fibre is given by $\Big\}$ $P = (P_2 - P_1)\,dB$

where, P_1 - Power output without bending in dB

P_2 - Power output with bending in dB

4) Diagram.



8

5) observations

S.No	Power output without bending (P_1) dB		Power output with bending (P_2) dB		$P=(P_2-P_1)$ dB	
	1m	5m	1m	5m	1m	5m

Mean $P_{(1m)}$ = ... $_{5m)}$ = $\frac{}{5}$

= dB

6) Calculations

$l = 1m$;

$P =$

$l = 5m$

$P =$

7) Result:

The bending loss of given optical fibre ($l=1m$) $P=$ ____ dB

($l=5m$) $P=$ ____ dB

Expt No: 5

5. Energy band gap of given Semiconductor Diode

1) **Aim:**

To determine the energy band gap of given "Semiconductor" diode.

2) **Apparatus Required:**

1) Energy band gap kit
2) Thermometer
3) connecting wires etc.

3) **Formula**

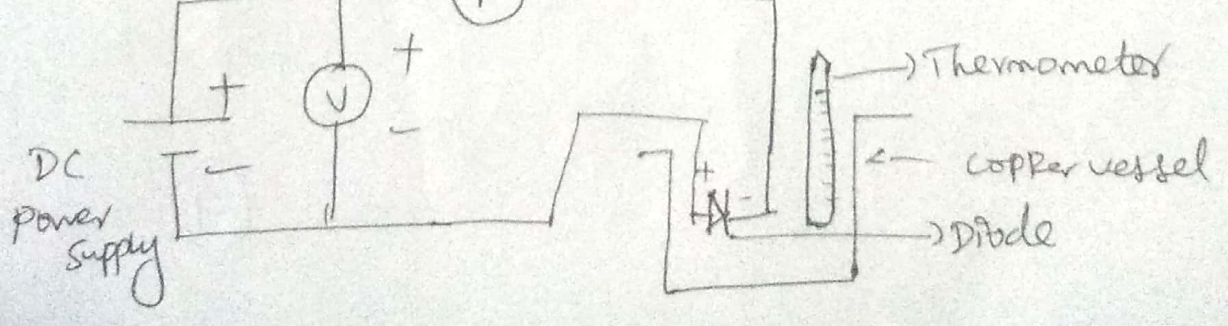
The energy band gap of given semiconductor diode is $\left.\right\}$ $E_g = (0.198 \times \text{slope})\ eV$

Where, slope $= \dfrac{\Delta \log_{10} I_s}{\Delta\left(\dfrac{1000}{T}\right)} = \ldots$

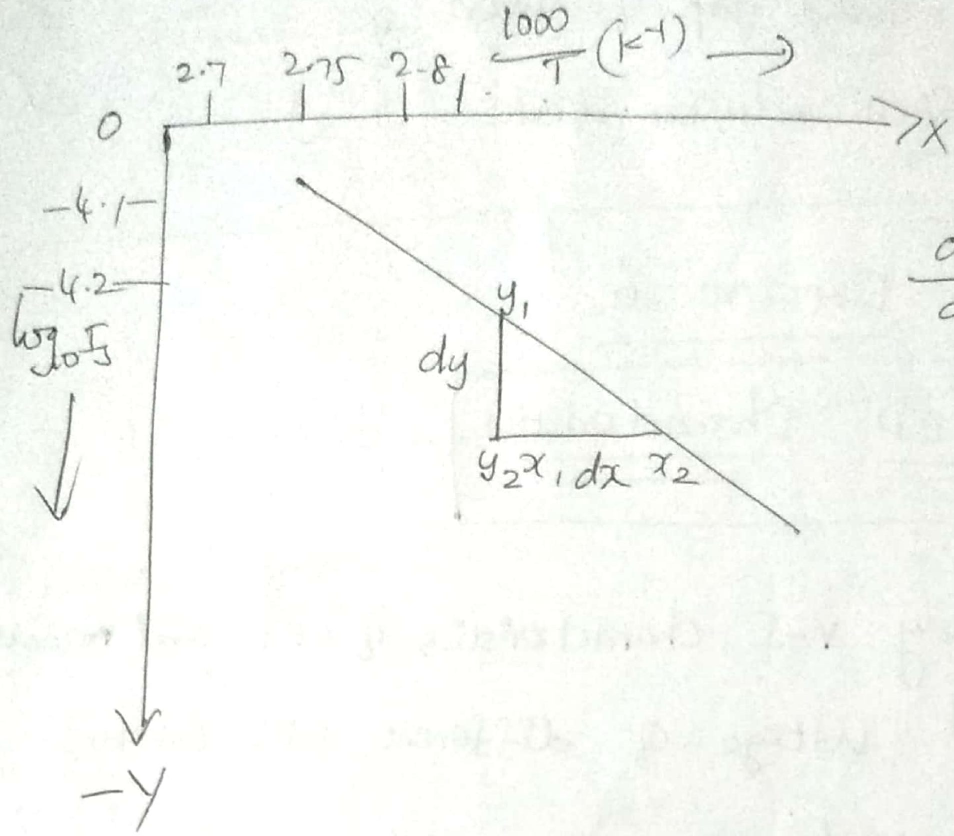
I_s - reverse saturation current in μA

T - Temperature in 'K'

4) **Circuit Diagram**



5. Model graph



$$\frac{dy}{dx} = \frac{\Delta \log_{10} I_s}{\Delta\left(\frac{1000}{T}\right)} = \ldots$$

6. Observations.

i) Biasing voltage given to the diode = ... V

ii) Room temp = ____ °C

S.No	T °C	T K 273+°C	I_s (μA)	$\frac{1000}{T}$ (K^{-1})	$\log_{10} I_s$

7. Calculations

$$E_g = 0.198 \times \text{slope eV}$$

Slope = ...

$$E_g = 0.198 \times \ldots = \ldots \text{eV}$$

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8. Result:

The energy band gap of given semiconductor diode $\} E_g = \ldots eV$

Expt. No: 6

6. LED Characteristics

1) Aim:-

To study V-I characteristics of LED and measure the threshold voltage of different LED colours.

2) Apparatus Required:

1. LED kit
2. Connecting wires etc.

3) Formula

$$\boxed{E_g = \frac{hc}{\lambda} \, eV}$$

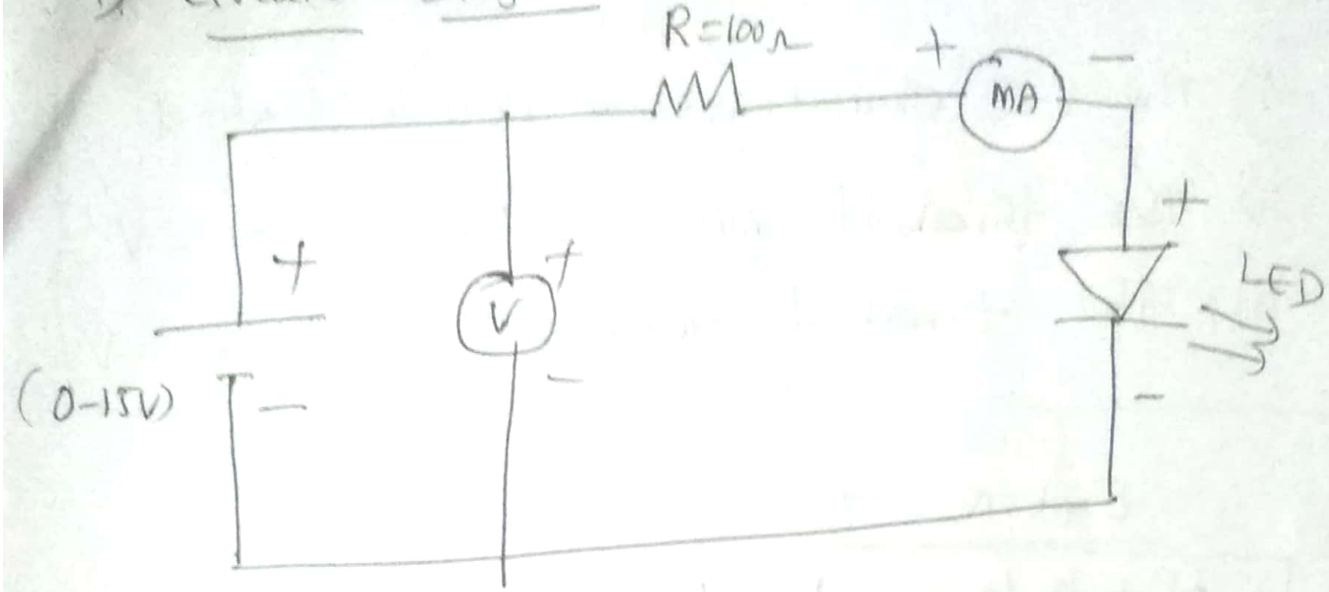
$E_g = E_c - E_v$ eV

where, h = planck's constant - J-s

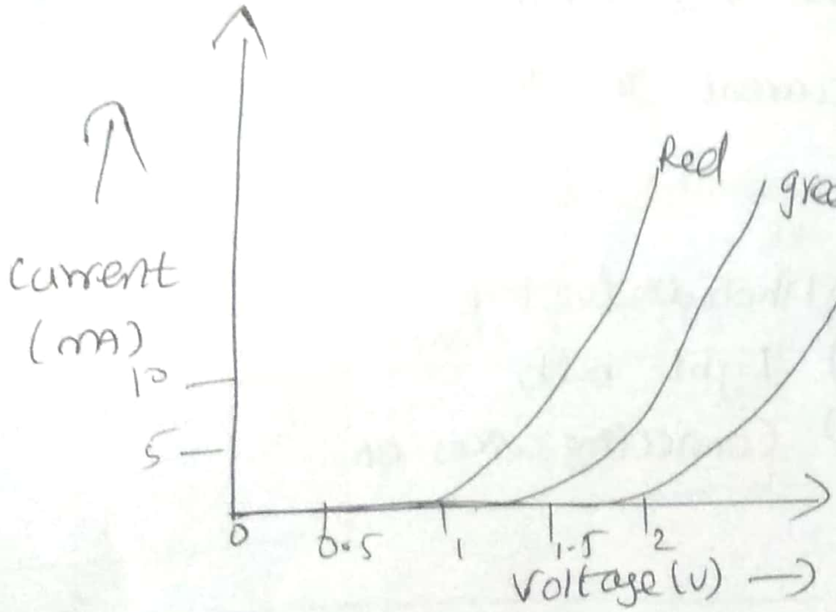
c = velocity of light - m/s

λ = wavelength of emitted radiation (A°)

4) Circuit Diagram



5) Model graph



6) observations

S.No	Voltage (V)	Current (mA)	
		Blue	Red

7) Result:

i) The V-I characteristics of LED is studied

ii) The threshold voltage of Blue LED = ...V

iii) The threshold voltage of Red LED = ...V

Expt. No: 7

7. Photodiode Characteristics

1) Aim:

To study the V-I characteristics ~~of P~~ and measure the dark current in the photodiode.

2) Apparatus Required:

i) photodiode kit
ii) Light bulb
iii) Connecting wires etc.

3) Formula:

Total current in the photo diode I_t = Dark current $(I=0)$ + Photocurrent $(I\neq0)$

$$I_T = I_d + I_p$$

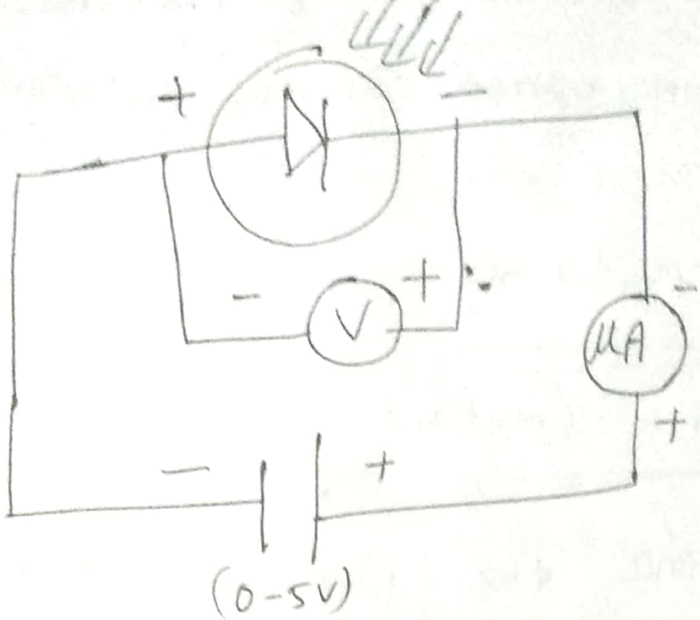
where, I – Intensity of Light

I_T – Total current in the photo diode

I_p – photo current in μA

I_d – dark current in μA

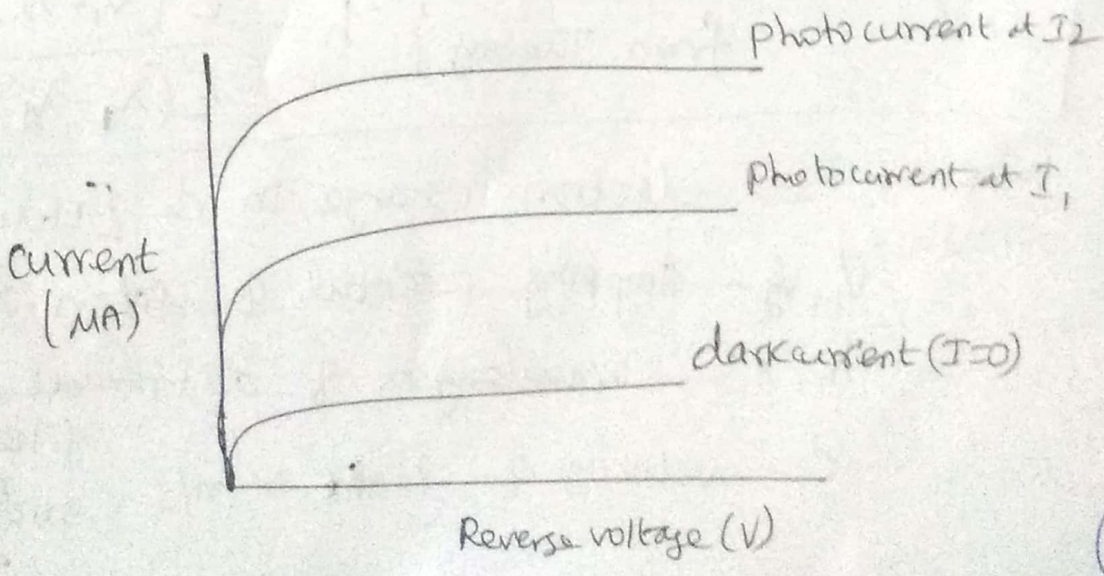
4) Circuit Diagram



6) Observations

S.No	Dark current $I=0$		photocurrent at I_1		photocurrent at I_2	
	V (V)	I(μA)	V(V)	I(μA)	V(V)	I(μA)

5) Model graph



7) Result

i) The V-I characteristics of photodiode is studied

ii) The dark current in the photodiode = μA

Expt. No: 09

9. Planck's Constant

1) Aim:

To determine the planck's constant using photocell

2) Apparatus Required:

1) Photocell
2) Colour filters
3) Light source
4) planck's constant apparatus
5) Connecting wires etc.

3) Formula:

The planck's constant from Theory $\Big\}$ $h = \dfrac{e(V_1 - V_2)\lambda_1\lambda_2}{C(\lambda_1 - \lambda_2)}$ J-S

Where, e - electron charge in C $[1.6 \times 10^{-19} C]$

V_1, V_2 - Stopping potential of filters in volts

λ_1, λ_2 - wavelength of different Colour filters

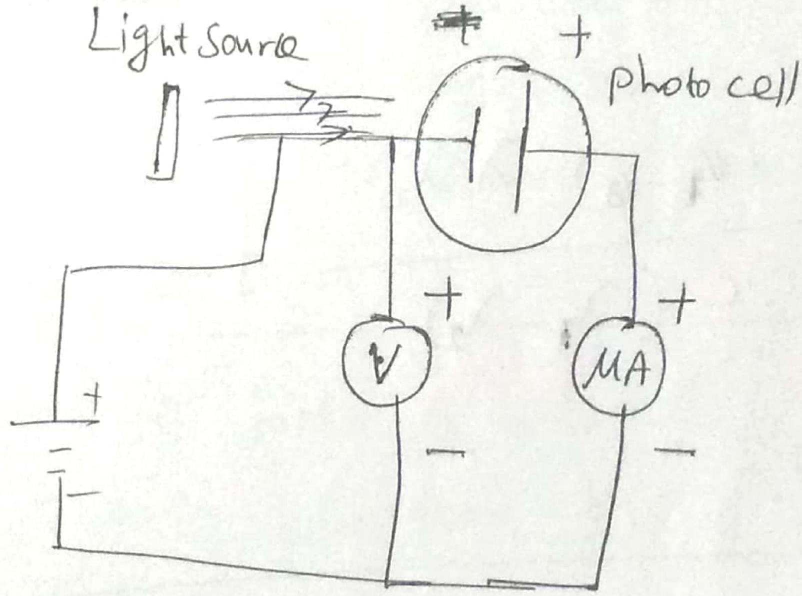
C - velocity of light in m/s $(3 \times 10^8 m/s)$

ii) The planck's constant using graph } $\frac{h}{e}$ = slope

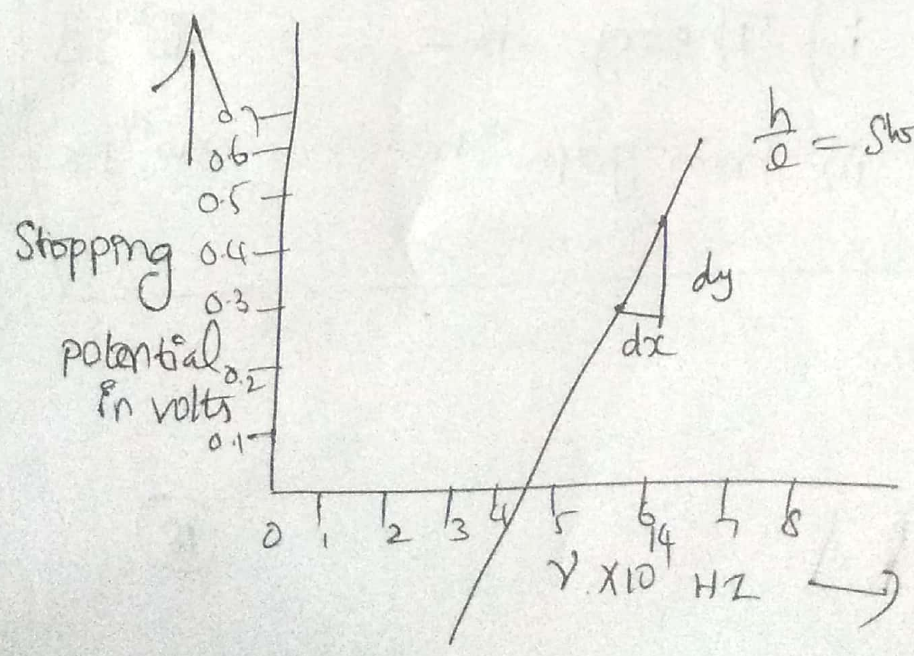
h = slope × e J-S

where slope = $\frac{\Delta V \text{ in volts}}{\Delta \nu \text{ in Hz}}$ = . . .

4) Circuit Diagram



5) Model graph



$\frac{h}{e}$ = slope = $\frac{dy}{dx} = \frac{\Delta V}{\Delta \nu \times 10^{14}}$

$\frac{h}{e}$ = . . $\times 10^{-14}$

$h = e \times \cdot \times 10^{-14}$

$h = 1.6 \times 10^{-19} \times \cdot\cdot \times 10^{-14}$

$h = \qquad \times 10^{-33}$ J-S

6) Observations

S.No	Colour filters	Wavelength λ A°	frequency $\nu \times 10^{14}$ Hz $\nu = \frac{c}{\lambda}$	Stopping potential V_s (volts)	Planck's constant $h \times 10^{-34}$ J-S
1.	Blue	4860	6.17		
2.	Green	5400	5.56		
3	Orange	6000	5		

Mean h= ... $\times 10^{-34}$ J-S

7) Calculations

$$h = \frac{e\,(V_1 - V_2)\,\lambda_1 \lambda_2}{c\,(\lambda_1 - \lambda_2)} \text{ J-S}$$

8) Result:

i) The planck's constant

i) Theory h= ... $\times 10^{-34}$ J-S

ii) From graph h= ... $\times 10^{-34}$ J-S

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Ex. No: 10

10. Solar cell characteristics

1) Aim:

To study the V-I characteristics of solar cell and measure the fill factor of it.

2) Apparatus Required:

1) solar cell kit
2) Light source
3) Connecting wires etc.

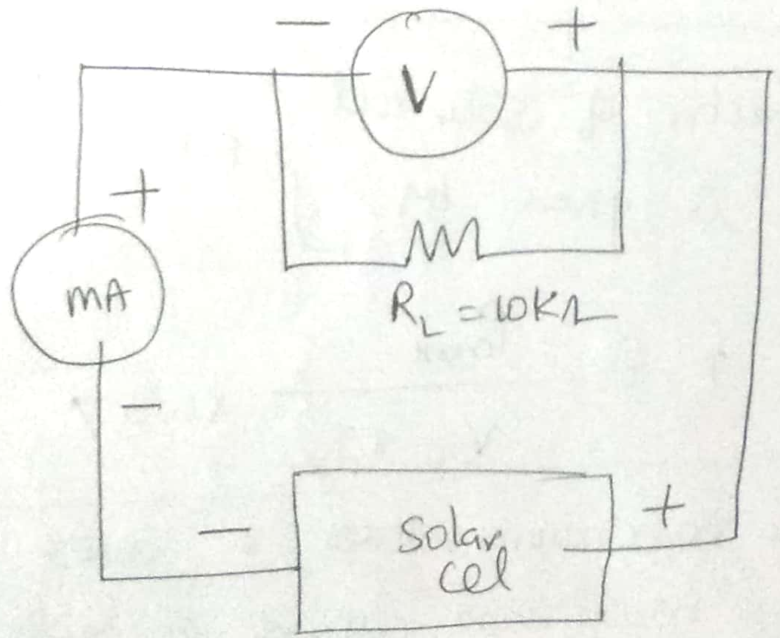
3) Formula

The fill factor of solar cell is given by $F.F = \dfrac{V_m * I_m}{V_{oc} \times I_{sc}} \times 100\%$

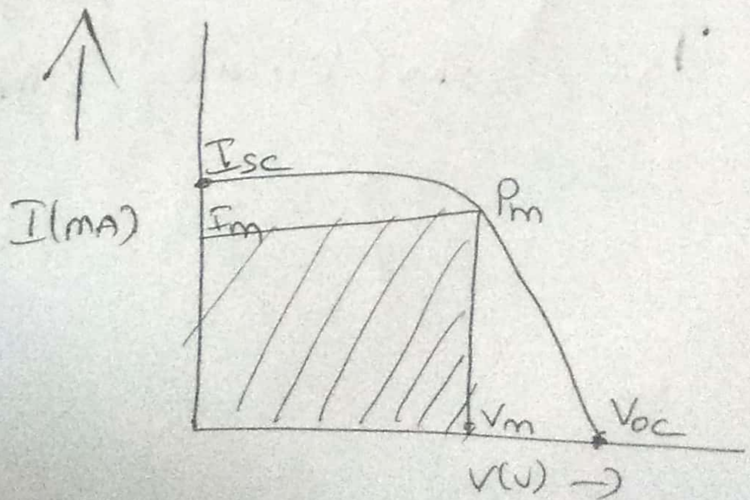
$$F.F = \frac{P_{max}}{V_{oc} \times I_{sc}} \times 100\%$$

Where
V_m - maximum voltage in volts
I_m - maximum current in mA
V_{oc} - Open-circuit voltage in V
I_{sc} - Short circuit current density in mA

4) Circuit Diagram



5) Model graph



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6) Observations

Load Resistance $R_L = 10k\Omega$

S.No	Voltage (V)	Current (mA)	$P_m = V_m \times I_m$ $P = V \times I$ (mW)

7) Calculations

P_r $I_m = ..A$ $V_m = ..V$

$V_{oc} = ..V$ $I_{sc} = ..A$

~~Fill Factor~~

$$F.F = \frac{V_m \times I_m}{V_{oc} \times I_{sc}} \times 100$$

$F.F = ...\%$

8) Result:

1) The V-I characteristics of solar cell is studied.

2) The fill factor of the solar cell at particular Intensity $\} F.F = ..\%$