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Title of the experiment :-

Measurement of Low dimensions by Laser Diffraction.

Objectives :-

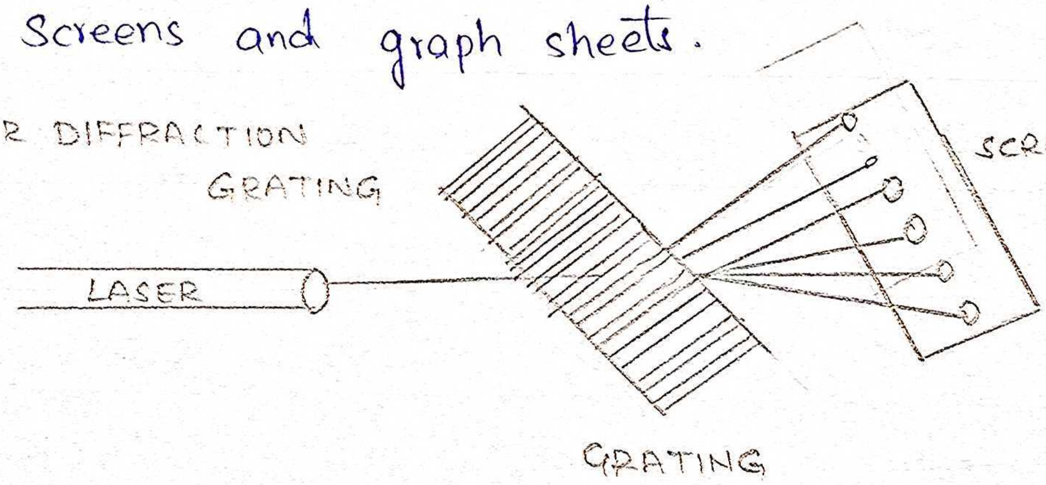
a) To determine the wavelength of the given laser source using a diffraction grating.

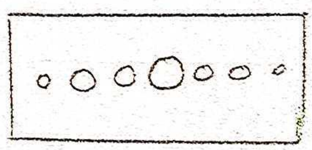
b) To determine the particle size of the thin film coated on the glass slide.

Equipment List :-

1. Laser source
2. Diffraction grating
3. Low dimension particles coated thin film
4. Screens and graph sheets.

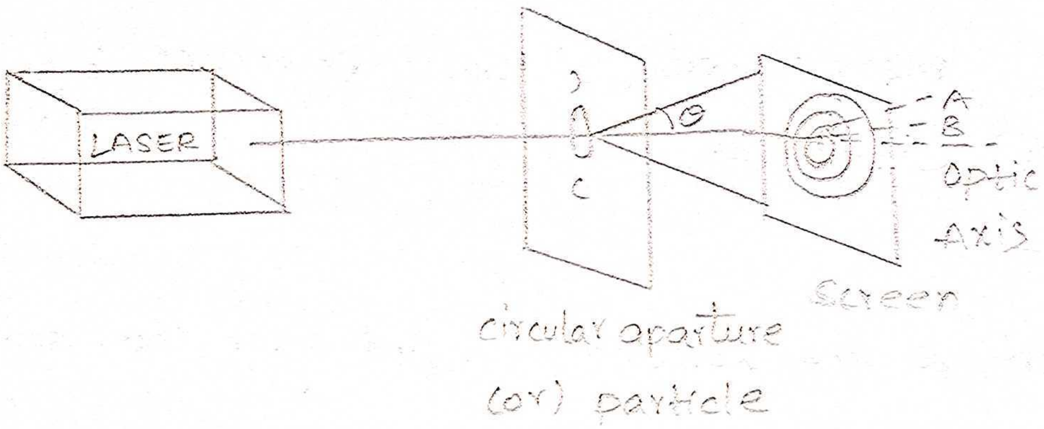
LASER DIFFRACTION GRATING

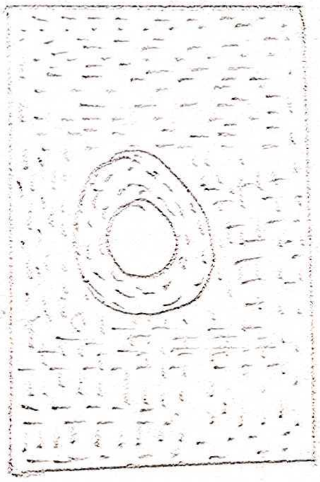




Formula :-

$$D = 1.22\, \lambda n \,(d/r_n)$$





Laboratory report :-

a) Determination of wavelength.

$d = 1.69 \times 10^{-6} m$

S.No.	Order of diffraction (n)	Distance between grating and diffraction spot (D) meter	Distance between diffraction spot and the center maxima (y) meter	θ	λ (nm)
1.	1	10 cm	3.4 cm	0.327	0.542
2.	2	18 cm	7.8 cm	0.662	0.549
3.	1	8 cm	2.7 cm	0.325	0.539
4.	2	8 cm	6.5 cm	0.682	0.565
5.	1	7 cm	2.5 cm	0.343	0.568
6.	2	7 cm	6.2 cm	0.885	0.723

Average wavelength $\lambda = 0.581 \times 10^{-9} m$

we know that;

$$\rightarrow \boxed{\theta = \tan^{-1}(Y/D)}$$

$$\theta_1 = \tan^{-1}\left(\frac{Y_1}{D_1}\right) = \tan^{-1}\left(\frac{3.4}{10}\right) = 0.327$$

$$\theta_2 = \tan^{-1}\left(\frac{Y_2}{D_2}\right) = \tan^{-1}\left(\frac{7.8}{10}\right) = 0.662$$

$$\theta_3 = \tan^{-1}\left(\frac{Y_3}{D_3}\right) = \tan^{-1}\left(\frac{2.7}{8}\right) = 0.325$$

$$\theta_4 = \tan^{-1}\left(\frac{Y_4}{D_4}\right) = \tan^{-1}\left(\frac{6.5}{8}\right) = 0.682$$

$$\theta_5 = \tan^{-1}\left(\frac{Y_5}{D_5}\right) = \tan^{-1}\left(\frac{2.5}{7}\right) = 0.343$$

$$\theta_6 = \tan^{-1}\left(\frac{Y_6}{D_6}\right) = \tan^{-1}\left(\frac{6.2}{7}\right) = 0.885$$

$\rightarrow \lambda = d \sin\left(\frac{\theta}{n}\right)$

$\lambda_1 = 1.69\times10^{-9} \sin\left(\frac{0.327}{1}\right) = 1.69\times10^{-9} \times 0.321 = 0.542\times10^{-9}$

$\lambda_2 = 1.69\times10^{-9} \sin\left(\frac{0.662}{2}\right) = 1.69\times10^{-9} \times \sin(0.331)$

$= 1.69\times10^{-9} \times 0.324 \doteq 0.549\times10^{-9}$

$\lambda_3 = 1.69\times10^{-9} \sin\left(\frac{0.325}{1}\right) = 1.69\times10^{-9} \times \sin(0.325)$

$= 1.69\times10^{-9} \times 0.319 \doteq 0.539\times10^{-9}$

$\lambda_4 = 1.69\times10^{-9} \times \sin\left(\frac{0.682}{2}\right) = 1.69\times10^{-9} \times \sin(0.341)$

$= 1.69\times10^{-9} \times 0.334 = 0.565\times10^{-9}$

$\lambda_5 = 1.69\times10^{-9} \times \sin\left(\frac{0.343}{1}\right) = 1.69\times10^{-9} \times 0.336 = 0.568\times10^{-9}$

$\lambda_6 = 1.69\times10^{-9} \sin\left(\frac{0.885}{2}\right) = 1.69\times10^{-9} \times \sin(0.4425)$

$= 1.69\times10^{-9} \times 0.428$

$= 0.723\times10^{-9}$

$$\text{Average wavelength } (\lambda) = \frac{0.542 + 0.549 + 0.539 + 0.565 + 0.568 + 0.723}{6}$$

$$= \frac{3.486}{6} = 0.581 \text{ nm}$$

$$= 0.581 \times 10^{-9} \text{ m}$$

Results :-

1. The wavelength of the Laser = 0.581×10^{-9} m

2. The width of the single slit = 21.31×10^{-9} m

Precautions:-

1. The laser beam, either direct or reflected must never reach the eyes. It is extremely dangerous for the eyes.
2. The laser beam should be handled very carefully.