# Section - 2

① What do you understand by resolving power. Deduce the expression for resolving power of grating.

**Ans** **Resolving power of grating** —

It is defined as the ratio of wavelength ($\lambda$) of any spectral line to the smallest difference of two wavelengths ($d\lambda$), for which the spectral lines can be resolved at the wavelengths.

$$\text{Resolving power of grating} = \frac{\lambda}{d\lambda}$$

**Expression** :- Let a light consisting of two wavelength ($\lambda_1$) of any ~~spectral line~~ to the and $\lambda_2$ is incident normally on a grating element ($e+d$) and the spectral lines corresponding to $\lambda_1$ and $\lambda_2$ are formed on screen $P_1$ and $P_2$.

② These spectral lines, just resolve if they satisfy the Rayleigh's criterion. the direction of $n^{th}$ principal maxima for wavelength $\lambda_1$ is given by

$$(e+d)\sin\theta = n\lambda_1$$
$$N(e+d)\sin\theta = Nn\lambda_1$$

③ And 1st minima in direction ($\theta = d\theta$) is

$$N(e+d)\sin(\theta + d\theta) = n\lambda_2$$

except $(m = 0, N, 2N \cdots$ or $1, 2, 3 \cdots N-1)$

When $m = n(N+1)$, e.g.

$N(e+d)\sin(\theta + d\theta) = (nN+1)\lambda_1$

The principal maxima due to wavelength $\lambda_2$ in direction $(\theta + d\theta)$ is $e+d\sin(\theta+d\theta) = n\lambda_2$

$$N(e+d)\sin(\theta+d\theta) = Nn\lambda_2$$

Comparing eq, we get,

$$(nN+1)\lambda_1 = Nn\lambda_2$$

If $\lambda_1 = \lambda$, $\lambda_2 = \lambda + d\lambda$ & $d\lambda = \lambda_2 - \lambda_1$ e.g.

$$N(N+1)\lambda = Nn(\lambda + d\lambda)$$

or $\lambda = Nnd\lambda$. (or) $\frac{\lambda}{d\lambda} = nN$

But - $e+d\sin\theta = n\lambda$

or $n = \frac{(e+d)\sin\theta}{\lambda}$

$$\boxed{\frac{\lambda}{d\lambda} = \frac{N(e+d)\sin\theta}{\lambda}}$$