2: DIFFRACTION OF LIGHT.

*. When light falls on obstacles or small apertures whose size is comparable with the λ of light, there is a departure from straight lines propagation, the light bends round the corners of the obstacles or apertures and enters in the geometrical shadow. This bending is called diffraction.

*. DIFFERENCE B/w Interference & Diffraction:

1). In Interference, the interaction takes place b/w two separate wavefronts originating from the two coherent sources, while in diffraction the interaction takes place b/w the secondary wavelets ~~wavefronts~~ originating from different points of the exposed parts of the same wavefronts.

2). In Interference pattern the regions of minimum intensity are usually almost perfectly dark while this is not the case in diffraction.

3) The width of the fringes in interference may or may not be equal or uniform while in diffraction pattern fringe width of various fringes are never equal.

4). In an interference pattern all the maxima are of same intensity but in diffraction pattern they are of varying intensity.

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DIFFRACTION DUE TO N Parallel slits (PLANE TRANSMISSION GRATING)

Construction :-

An arrangement consisting of large no. of parallel slits of the same width and separated by equal opaque spaces is known as diffraction grating.

The gratings are constructed by ruling equidistant parallel lines on a transparent material such as glass with a fine diamond point. The ruled lines are opaque to light while the space between any two lines is transparent to light and acts as slit. This is known as Plane transmission grating. In order to get appreciable deviation of light the spacing between the lines is of the order of the wavelength of light.

Theory :-

The figure below represents the section of a plane transmission grating placed perpendicular to the plane of the paper.

Let e be the width of each slit and d is the width of each opaque part. Then, (e+d) is known as grating element.

Resolving Power of Optical Instruments

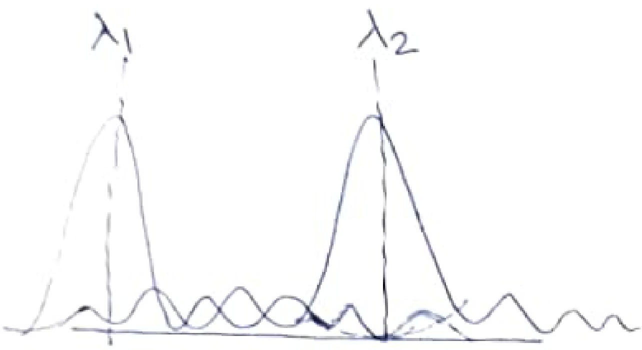
Meaning of resolving power :-

When two objects are very near to each other or they are ~~at~~ at very large distance from our eye, the eye may not be able to see them as separate. To see them separately, optical instruments such as telescope, microscope etc for close objects and prism and grating for spectral lines are employed. An optical instruments is said to be able to resolve two point objects if the corresponding diffraction patterns are distinguishable from each other. The ability of the instrument to produce their separate patterns is known as resolving power.

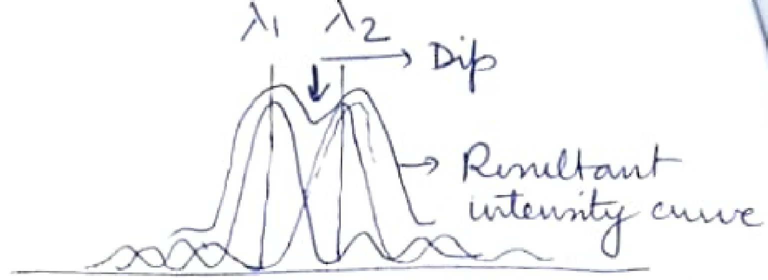
RAYLEIGH'S CRITERION OF RESOLUTION

According to Rayleigh's criterion, two point sources are resolvable by an optical instrument when the central maxima in the diffraction pattern of one falls over the first minimum in the diffraction pattern of the other and vice-versa.

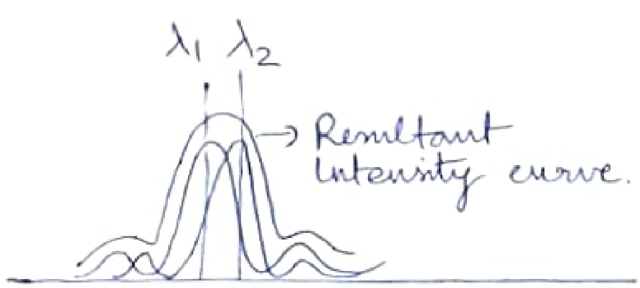
In order to illustrate the criterion let us consider the resolution of two wavelengths λ_1 & λ_2 by a grating.



(a)
(Well resolved)



(b) (Just resolved)



(c). (Not resolved)

Figure (a) shows the intensity curves of the diffⁿ pattern of two wavelengths. The difference in wavelengths is such that their principal maxima are separately visible. There is a distinct point of zero intensity in b/w the two. Hence, the two wavelengths are well resolved.

Figure (b) :- If the difference in the wavelengths is smaller such that the principal maxima coincides with the first minima of the other., the resultant intensity curve shows a distinct dip in the middle of two central maxima. There is noticeable decrease in intensity b/w the two central max^m indicating the presence of two different wavelengths (Just resolved)

c) Figure C is the case when the difference in wavelengths is so small that the central maxima corresponding to two wavelengths still comes closer. The resultant intensity curve is smooth without any dip giving the impression of one wavelength source only. Hence the two wavelengths are not resolved.

RESOLVING POWER OF A GRATING

Resolving power of a grating is defined as the capacity to form separate diffraction maxima of two wavelengths which are very close to each other. It is measured by $\lambda / d\lambda$, where $d\lambda$ is the smallest difference in two wavelengths which are resolvable by grating and λ is the wavelength of either of them or mean wavelength.

Expression for Resolving power :-