Engineering Physics 1
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Module-04
Lecture-02
Diffraction Part - 02

In the previous lecture I discussed single slit and double slit Fraunhofer diffraction. Now I am going to discuss in this lecture from hopper diffraction pattern of n parallel slits.

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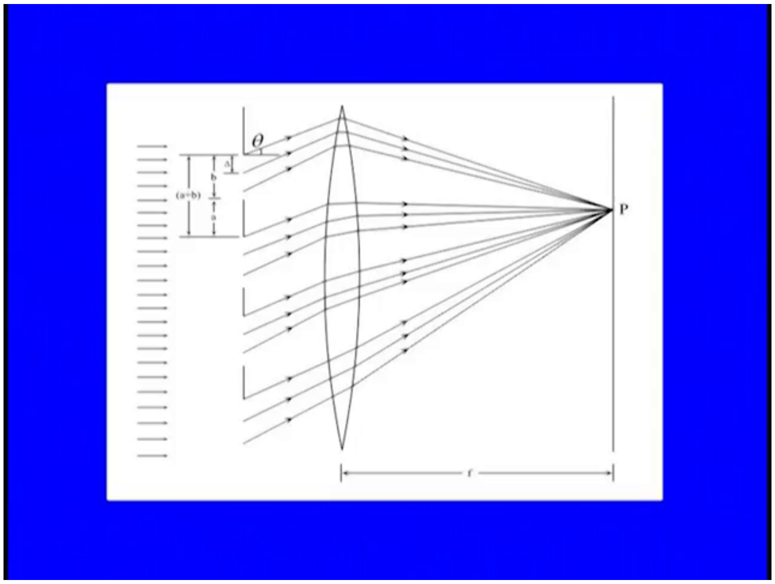

Each of width b and separated by equal optic spaces a as shown in this figure. This type of arrangement is known as diffraction grating. We will see that the diffraction pattern gets modified by the number of slits is increased beyond 2. Let a plane wave front of light of wave length lambda b incident normally on the slit as shown in this figure.

According to the principle of Huygens Reynolds had destined the incident wave front occupies the plane of the slits every point in each slit he is regarded as the origin of secondary spherical wavelets which is spread out in all directions. Therefore the rays are deflected from each slit in all directions if capital A is the resultant amplitude of light from a single slit along the normal to the plane of the slits.

Then resulting amplitude in a direction making an angle theta with the normal will be capital A sine beta by beta where beta = Pi by lambda b sine theta. Therefore in the case of n parallel slits of equal width we can replace all the secondary wavelets in each slit.

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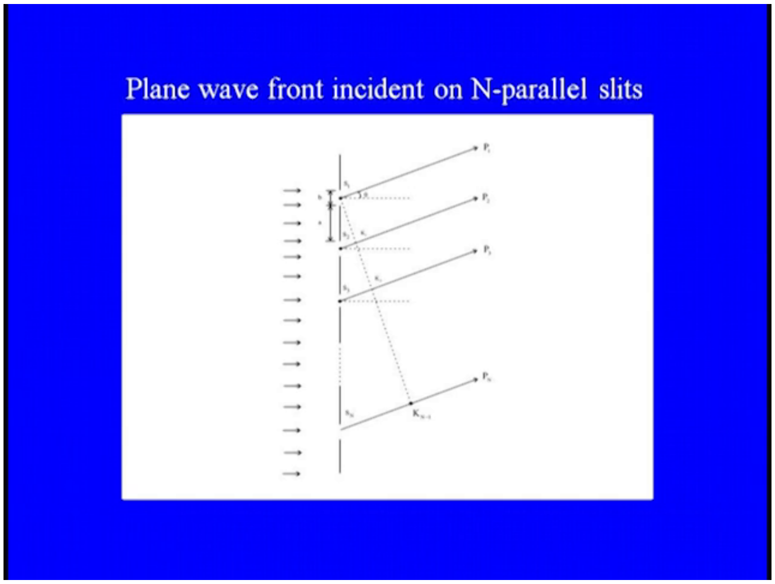

By a single wave of amplitude capital A sine beta by beta starting from its middle point like S1, S2, S3 so on and travelling at angle theta with the normal. Let us now find the resultant effect of these n by raisins when brought to focus by a convergent lens. To calculate the power difference between the reflected waves from successive slits from S1 we draw perpendicular S1 kn - 1 on the parallel paths of these vibrations.

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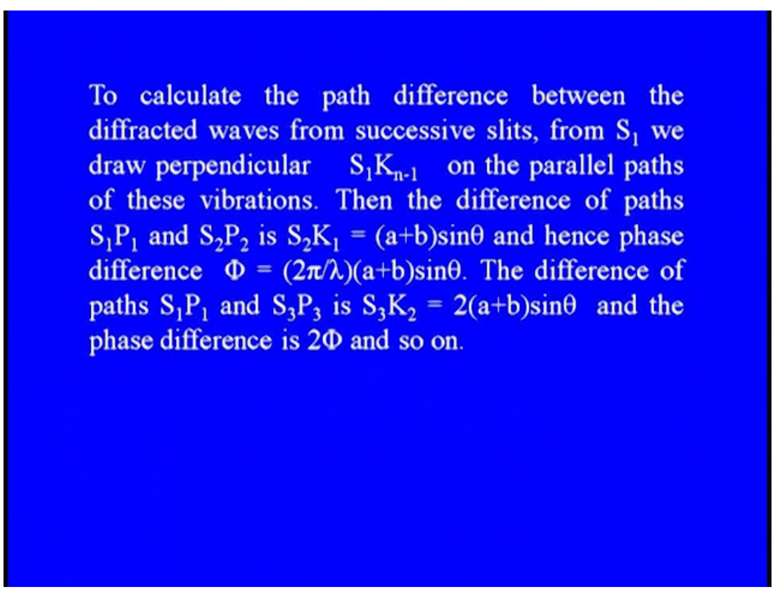

Then the difference of paths S1 P1 and S2 P2 is S2 K1 which is = a + b sine theta and hence phase difference Phi would be 2Pi by lambda into a + b sine theta. Similarly the difference of paths S1 P1 and S3 P3 is S3 K2 which is = 2 times a + b sine theta and hence the phase difference will be 2Pi. Similarly we can calculate the phase difference between the other reflected waves.

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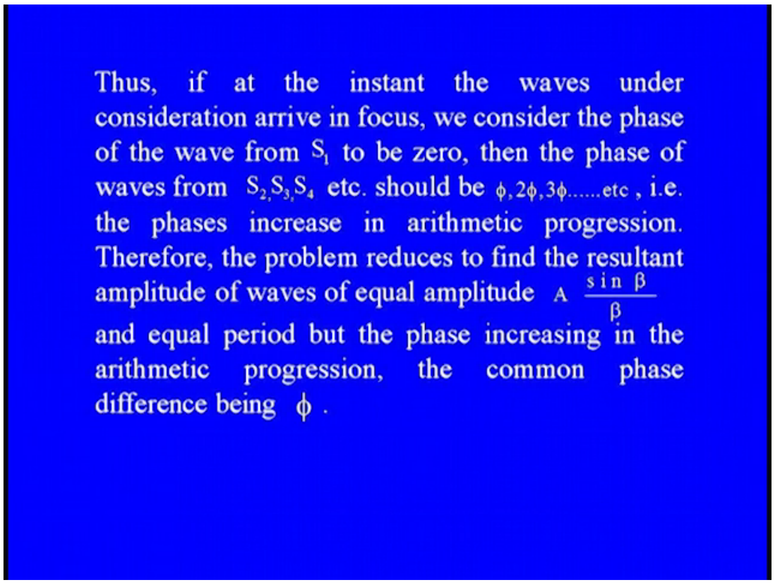

Thus if at the instant the waves under consideration arrive in focus we consider the phase of the wave from S1 to be 0 then the phase of waves from S2, S3, S4 so on, should be Phi, 2 Phi, 3 Phi etc., that is the phases increase in arithmetic progression therefore the problem reduces to find the resultant amplitude of n waves of empirical amplitude A sine beta by beta and equal period but the phase increasing in the arithmetic progression the common phase difference being Phi.

Therefore the resultant amplitude are be = A sine beta by beta into sine N Phi by 2 divided by sine PI by 2 where A sine beta by beta is the amplitude of single slit and beta = Pi b sine theta by lambda. If you write Phi by 2 = gamma which is = Pi by lambda into a + b sine theta then the resultant amplitude R will be = A sine beta by beta sine N gamma divided by sine gamma.

Therefore the intensity of the resultant wave will be = A square sine square beta by beta square sine square N gamma divided by sine square gamma.

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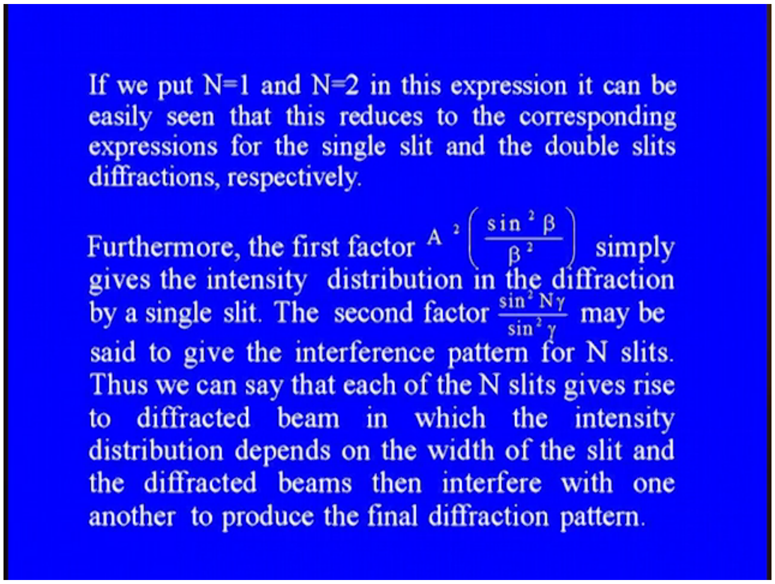

Now here if we put N = 1 and N = 2 in this expression we will find the result which we have already obtained for single slit and double slit diffraction pattern respectively. Further the first factor in this expression that is A square sine square beta by beta square simply gives the intensity distribution in the diffraction by a single slit. The second factor sine square n gamma by sine square gamma may be said to give the interference pattern for N slit.

Thus we can say that each of the N slit give rise to diffracted beam in which the intensity distribution depends on the width of the slit and the diffracted beam then interfere with one another to produce the final diffraction pattern. Now we can find out from this expression the position of maximum and minimum intensity on the screen.

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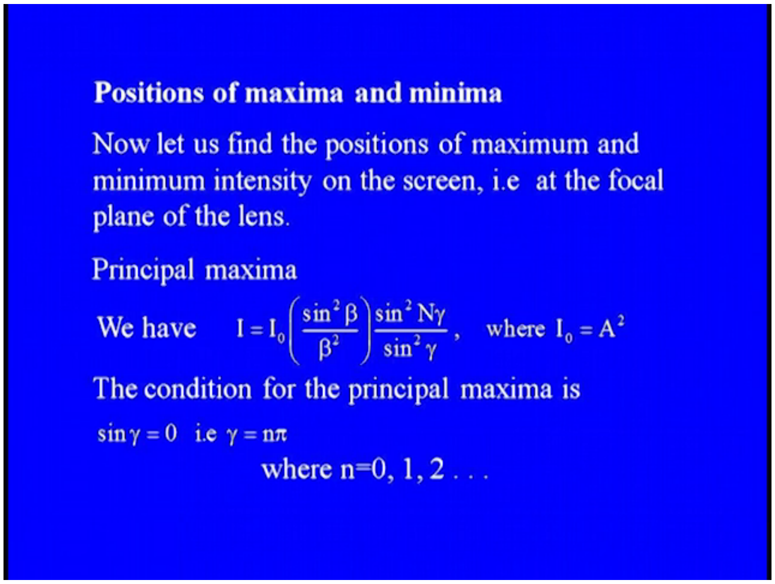

That is at the focal plane of the lens, now from the intensity equation I = I naught sine square beta by beta square into sin square N gamma upon sine square gamma. We can write the condition for principal Maxima that is where the intensity is maximum, so intensity will be maximum when sine is gamma = 0 that is gamma = n PI where n = 0, 1, 2, 3 etcetera.

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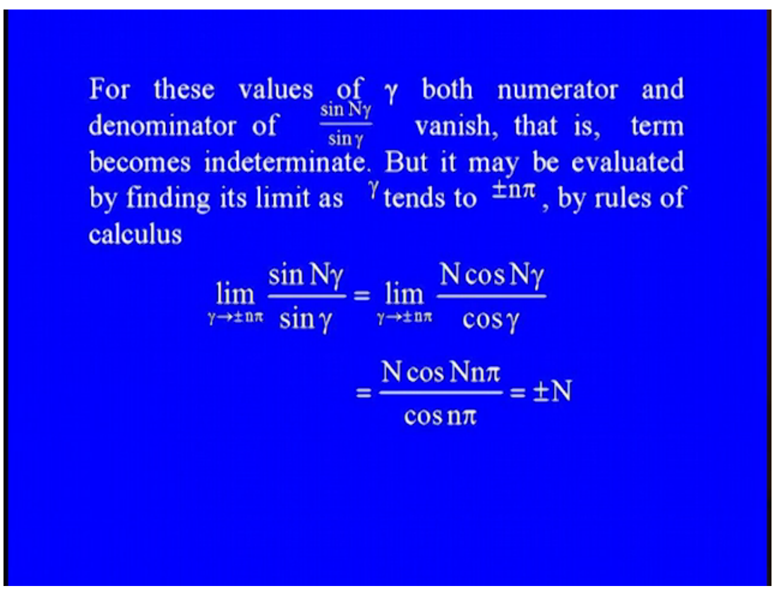

For this value of gamma both numerator and denominator of sine N gamma by sine gamma when that is term becomes indeterminate but it may be evaluated by finding its limit as gamma tends to + - N Pi. So, by method of calculus we can find the limit gamma tending to + - N PI sine N gamma by sine gamma = + - Capital N where capital N is the number of slits.

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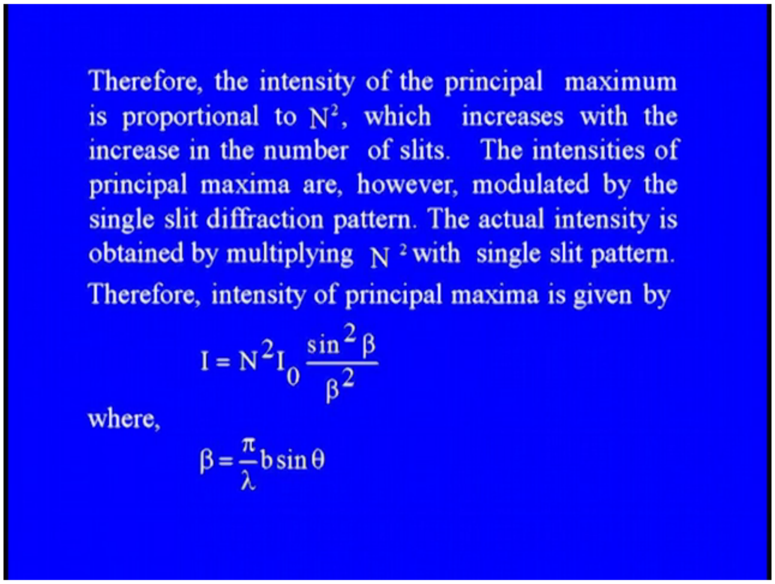

Therefore the intensity of the principal maximum is proportional to capital N square which increases with the increase in the number of slits. The intensities of principal Maxima are however modulated by the single slit diffraction pattern. The actual intensity is obtained by multiplying capital N square with single slit pattern. Therefore intensity of principal Maxima is given by N square into I naught into sine square beta by beta square where beta = PI by lambda into b sine theta.

Actually at the principal maxima the field produced by each of the slits are in phase and therefore they add up and the resultant field is N times the field produced by each of the slits.

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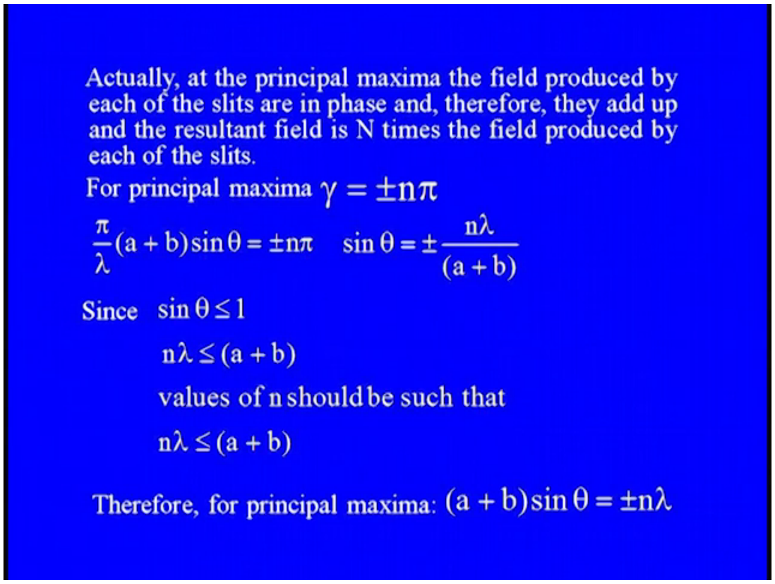

So, for principal Maxima we have gamma = + - n pi, so this condition we can write in terms of for a and b that is pi by lambda into a + b sine theta = + - n PI R sine theta = + - n lambda upon a + b. Since sine theta is less than or = 1 so we should have n lambda less than or = a + b. So, value values of n should be such that n lambda should be less than or = a + b.

Therefore for principal Maxima we have a + b sine theta = + - n lambda. This equation simply expresses the condition that if the difference of parts of the parallel deflector rays from any pair of corresponding points of grating is integral multiple of lambda then all the parallel reflected rays in that direction reinforce so as to form the principal maxima in the focal plane of the lens.

The whole number n in the ever equation represents the order of the interference maximum and physically it gives the number of wavelengths in the difference of paths of the deflected rays from any pair of corresponding points of the grating as shown in this figure here.

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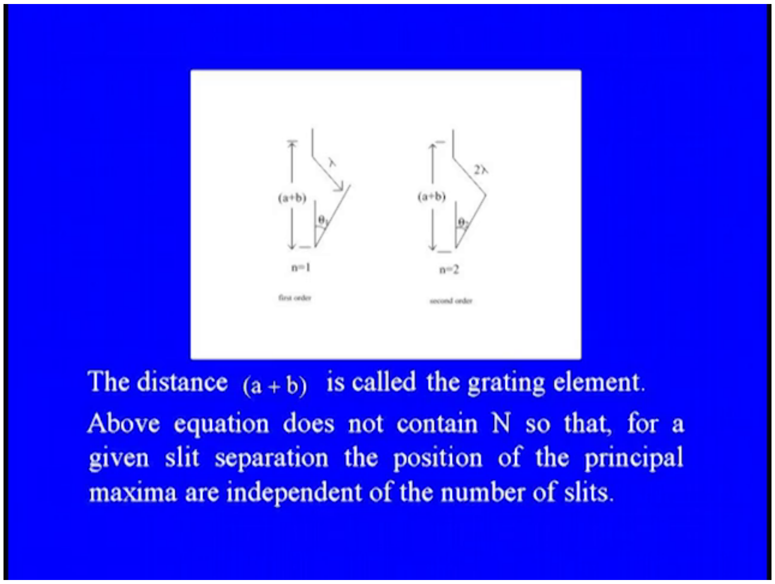

The distance a + b is called the grating element every equation does not contain capital N, so that for a given slit separation the position of the principal Maxima are independent of the number of slits. Now we can find out the position of minimum intensity from the expression of intensity.

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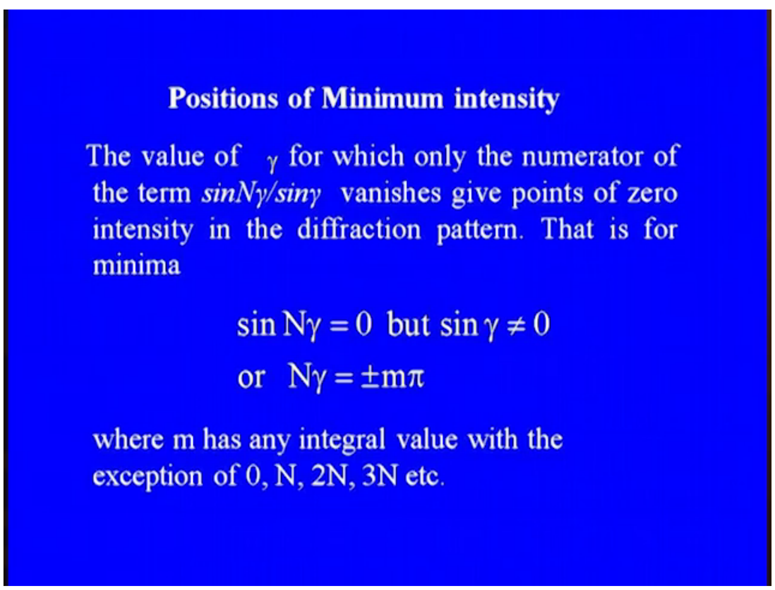

So, the value of gamma for which only the numerator of the term sine and gamma upon sine gamma vanishes give point of 0 intensity in the diffraction pattern that is for minima we should have sine and gamma = 0. But sine gamma should not be = 0 or we should have N gamma = + - m PI where m has any integral value with the exception of 0 capital N 2 time capital N 3 time capital N so on.

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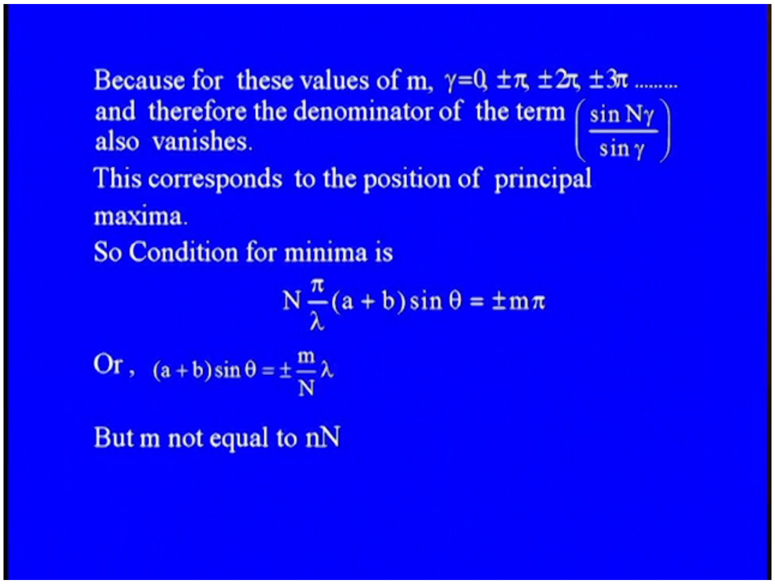

Because for these values of m gamma = 0 + - Pi + - 2 Pi + -3 Pi so on. And therefore the denominator of the term sine N gamma upon sine gamma also vanishes. These correspond to the position of principal maxima. So, condition for minima is capital N PI by lambda into a + b sine theta = + - m PI or a + b sine theta = + + m upon capital N times lambda but m should not be = n time capital N.

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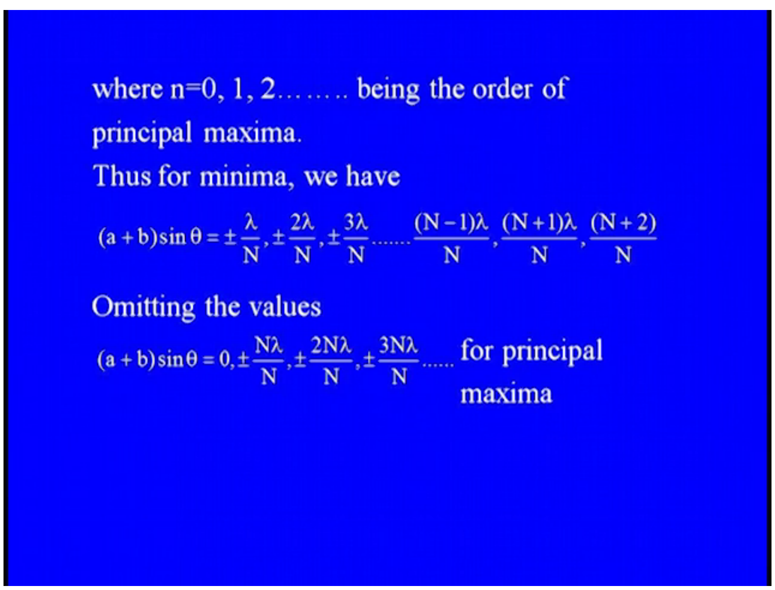

Where n small n has integral value 0, 1, 2, 3 so on and this n give the order of principle Maxima, thus for minima we have a + b sine theta = + - lambda upon capital N + - 2 lambda upon capital N + - 3 lambda upon capital N so on. Omitting the values a + b sine theta = 0 + - capital N lambda upon capital N + - 2 times capital N lambda upon capital N so on which are the condition for principle maximum.

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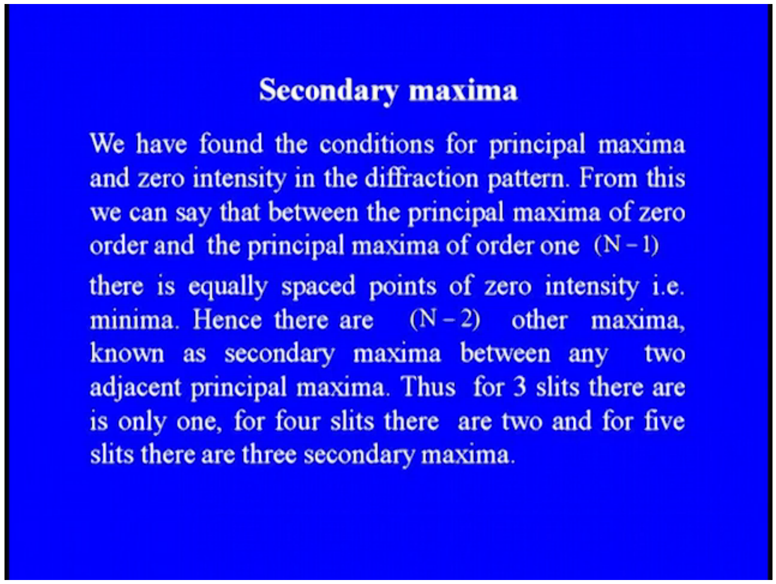

Now so we have found the condition for principal maxima and 0, intensity in the diffraction pattern. From this we can say that between the principal Maxima of 0 order and the principal Maxima of order 1 there is N - 1 there is equally spaced points of 0 intensity that is minimum. Hence there are N - 2 other Maxima known as secondary maxima between any two adjacent principal maxima.

Thus for 3 slits there are only 1, for4 slit there are 2 and for 5 slit there are 3 secondary maximum.

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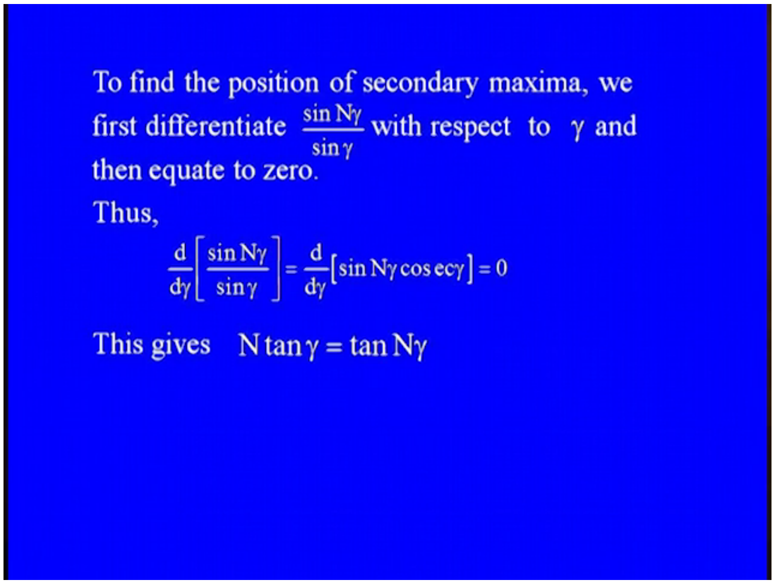

To find the position of secondary maxima we first differentiate sine N gamma upon sine gamma with respect to gamma and then equate it to 0. And thus if you differentiate this sine N gamma by sine gamma with respect to gamma and after equating it to 0, we will find capital N tan gamma = tan capital N gamma.

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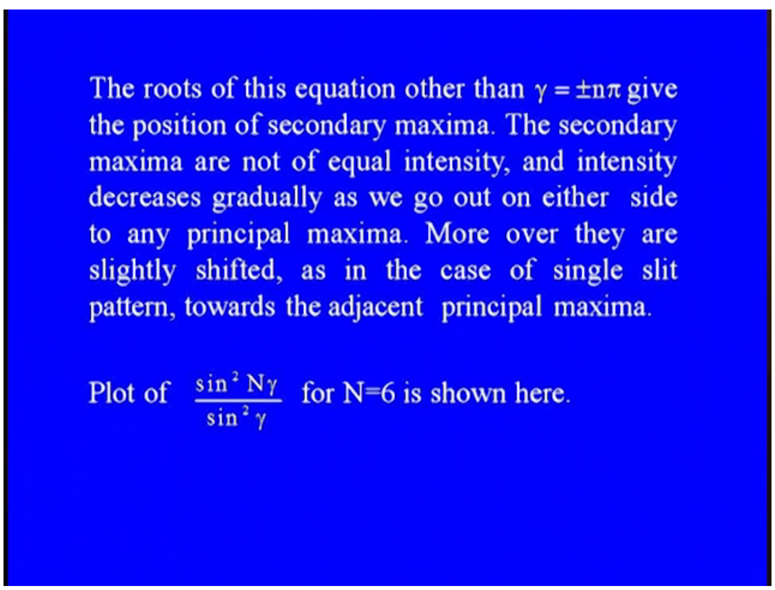

The root of this equation other than gamma is = + - n pi give the position of secondary maxima the secondary Maxima are not of equal intensity and intensity decreases gradually as we go out on either side to any principal maxima moreover they are is slightly shifted as in the case of single slit pattern towards the adjacent. Now the plot of sine square N gamma upon sine square gamma is shown here for N = 6.

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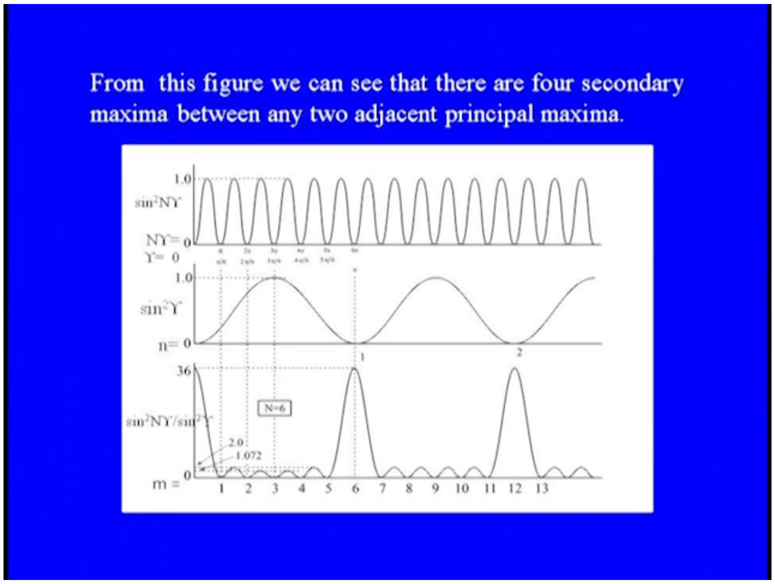

From this figure we can see that there are 4 secondary maxima between any two adjacent principal maxima which we have already discussed. Here it should be noted that the intensity of the principal Maxima are modulated by the single slit diffraction that is the plot of sine square N gamma upon sine square gamma is multiplied by I naught sine square beta by beta square the single slit diffraction pattern.

When n is very large that is when the number of slit is very large the principal Maxima will be much more intense in comparison to the secondary maximum. A particular principal Maxima may be absent if it corresponds to the angle which also determine the minimum of the single slit diffraction pattern.

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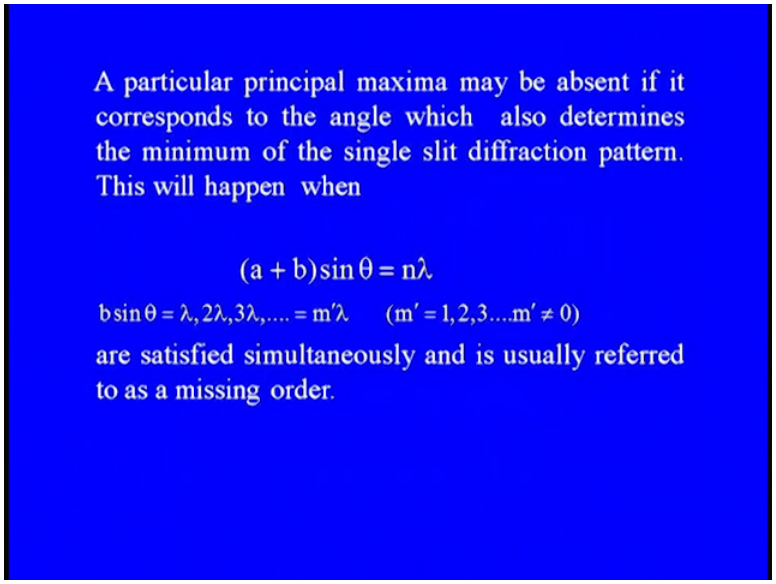

This will happen when a + b sine theta = n lambda and b sine theta = m prime lambda where m prime is = 1, 2, 3 so on but m prime is not is = 0 are satisfied simultaneously and is usually referred to as a missing order.

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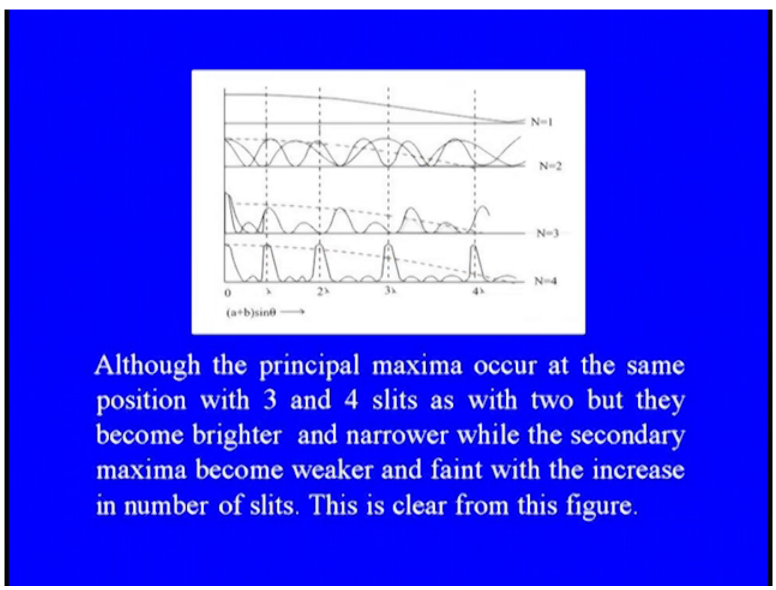

Although the principal Maxima occurs at the same position with 3 and 4 slits as with the two but they become brighter and narrower while the secondary Maxima become weaker and faint with the increase in number of slit this is clear from this figure. The extension to a very large number of slit as in actual grating say 15,000 lines per inch the Maxima become very narrow and observe intensity while the secondary Maxima are of negligible intensity indivisible in the pattern.

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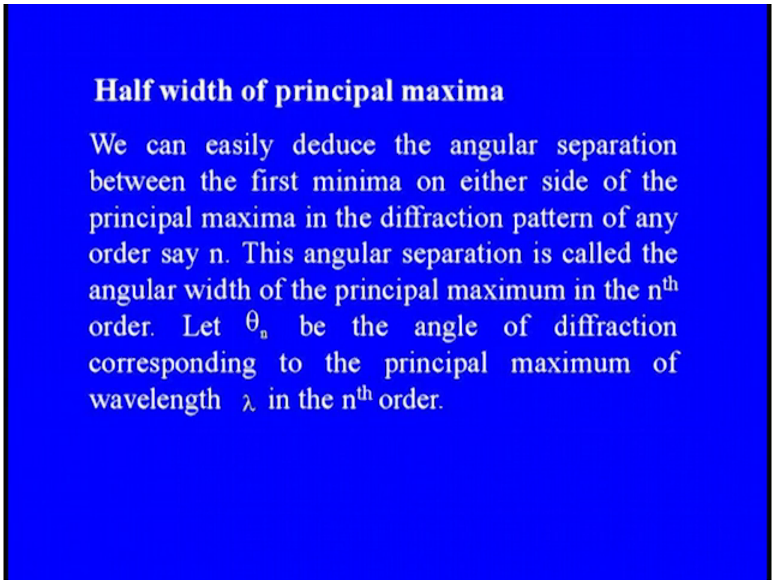

Now we can easily deduce the angular separation between the first minima on either side of the principal Maxima in the diffraction pattern of any order say and this angular separation is called the angular width of the principal Maxima in the nth order. Let theta n be the angle of diffraction corresponding to the principal maximum of wavelength lambda in the nth order.

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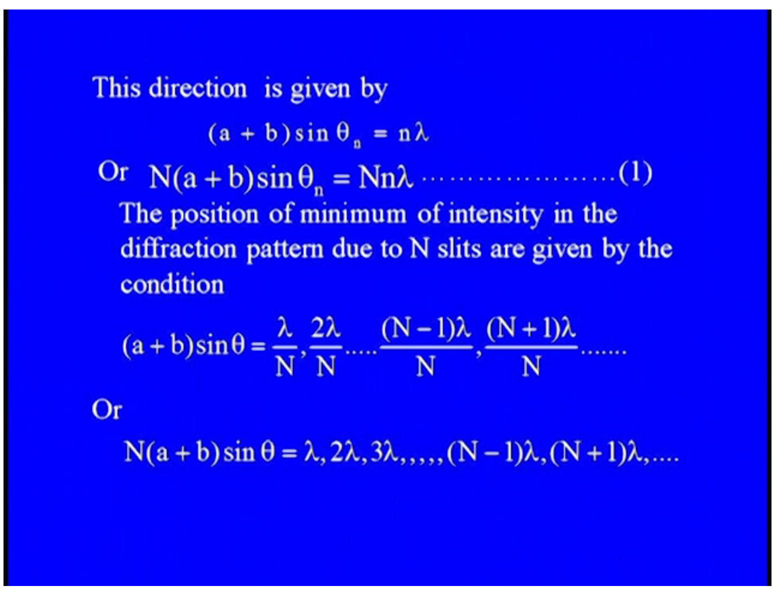

This direction is given by a + b sine theta n = n lambda or if we multiply capital N both sides we will get capital N times a + b sine theta n = capital N into small n into lambda the position of minimum of intensity in the diffraction pattern due to an slit are given by the condition a + b sine theta = lambda by capital N 2 lambda by capital N so on or capital N into a + b sine theta = lambda or 2lambda or 3 lambda.

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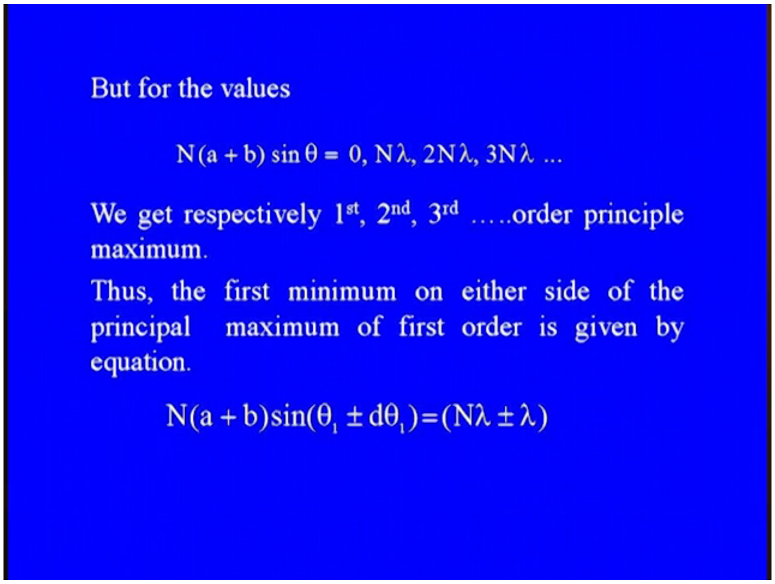

But for the values capital N into a + b sine theta = 0 capital N lambda or 2 time capital N lambda we get respectively first second so on order of principle maximum. Thus the first minimum on either side of the principle maximum of first order is given by equation capital N a + b sine theta 1 + - d theta 1 = capital N lambda + - lambda where the angle of deflection theta 1 corresponds to the principle maximum of first order.

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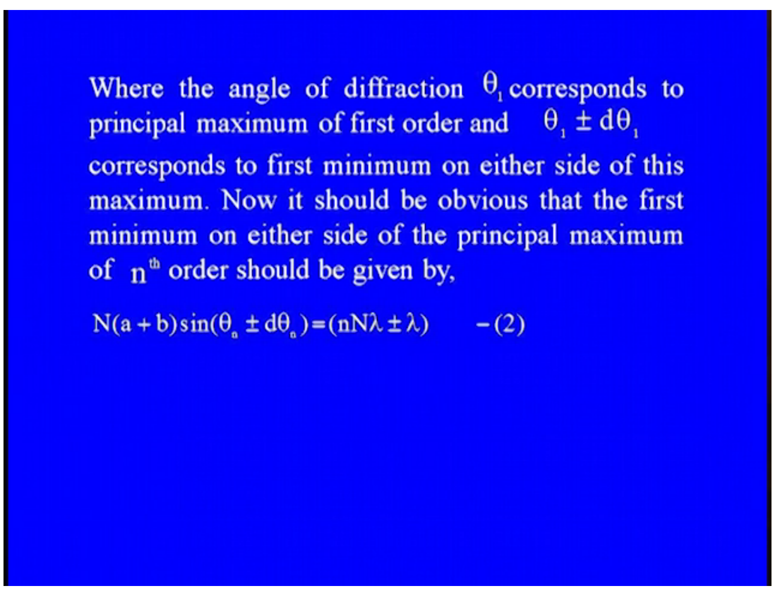

And theta 1 + - d theta 1 corresponds to the first minimum on either side of this maximum. Now it should be obvious that the first minimum on either side of the principle maximum of nth order is given by capital N into a + b sine theta n + - d theta n = small n into capital N into lambda + - lambda.

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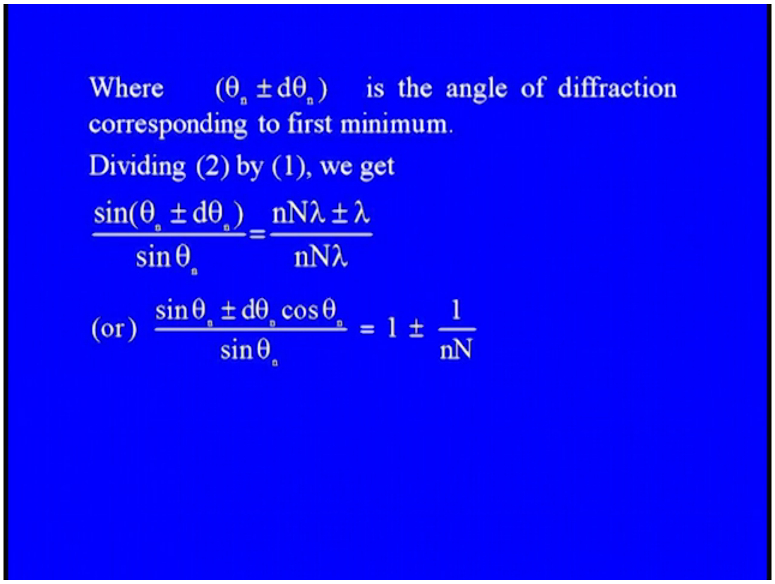

So, where theta 1 + - d theta n is the angle of diffraction corresponding to first minimum, so, by using the previous two equation we can write sine theta n + - d theta n divided by sine theta n = small n into capital N into lambda + - lambda divided by small n into capital N into lambda or sine theta n + - d theta and cos theta n divided by sine theta n = 1 + - 1 over is small n into capital N.

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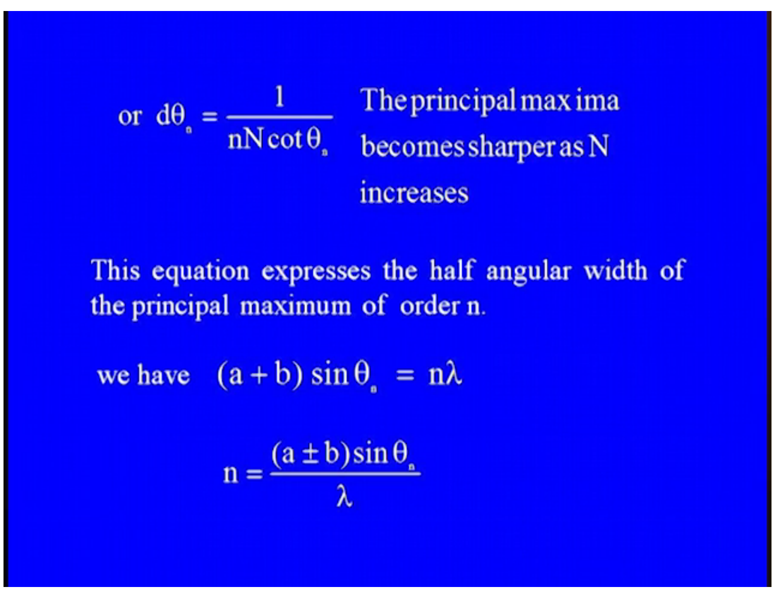

Or we can also write d theta n = 1over a small n into capital N cot theta n this equation expresses the half angular width of the principal maximum of order and we have a +b sine theta n = n lambda. So, we can write order of deflect tion n = a + - b sine theta n divided by lambda.

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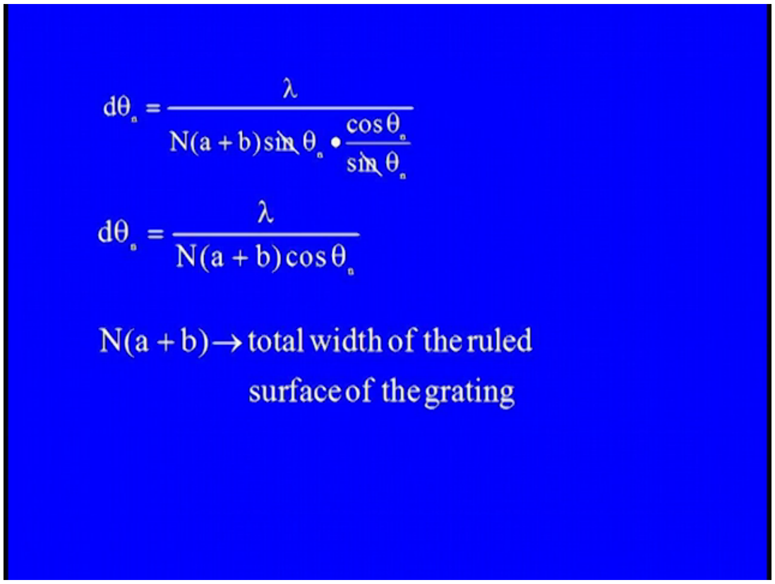

Or d theta n will be = lambda upon and into a + b sine theta n into cos theta n divided by sine theta n which we can simplify and we will get d theta n = lambda upon capital N into a + b cos theta n. Now here capital N into a + b is the total width of the ruled surface of grating.

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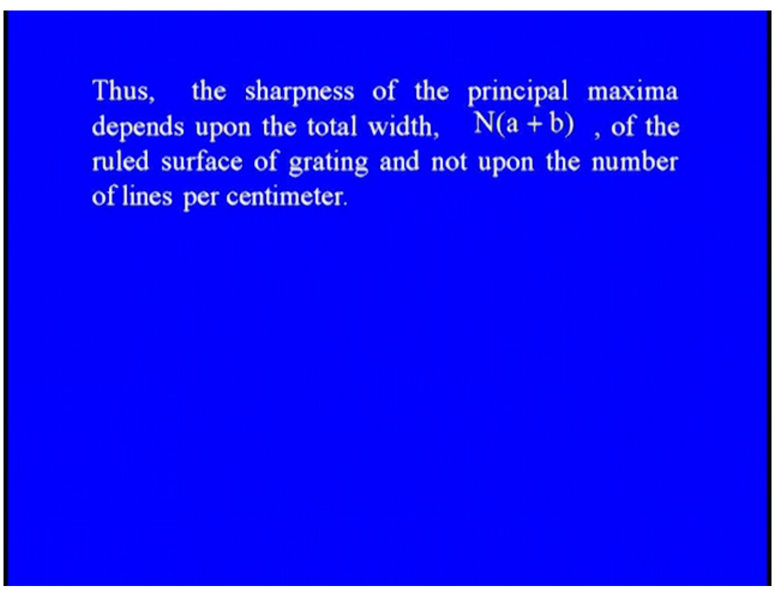

Thus the surface of the principal Maxima that is a smaller value of d theta n depends upon the total width N into a + b of the ruled surface of grating and not upon the number of lines per centimeter. Now I am going to describe how gratings are fabricated for laboratory use as we know an arrangement of a large number of equidistant slits is known as a diffraction grating. For narrow principal maximum that is surfer spectral lines a large value of capital N is required.

A good quality grating therefore requires a large number of slits typically of the order of 15,000 per inch this is achieved by ruling groups with a diamond point on an optically transparent sheet of material. The group's act as opaque spaces after each group is ruled the machine lifts the diamond points and move the seat forward for the ruling of the next group. Since the distance between the two consecutive groups is extremely small.

The moment of the seat is obtained with the help of the rotation of a screw which drives the carrier's carrying it.

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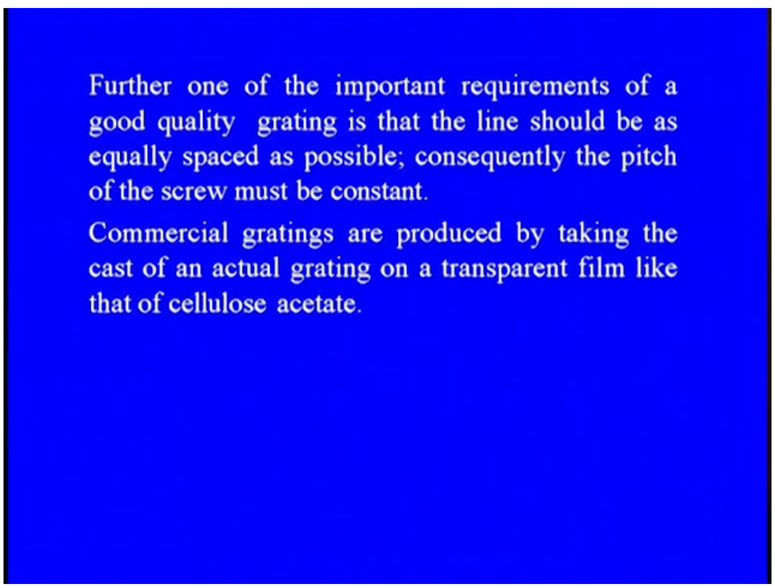

Further one of the important requirements of a good quality grating is that the line should be as equally spaced as possible. Consequently the pitch of the screw must be constant. Commercial gratings are produced by making the cost of an actual grating on a transparent film like that of cellulose acetate.

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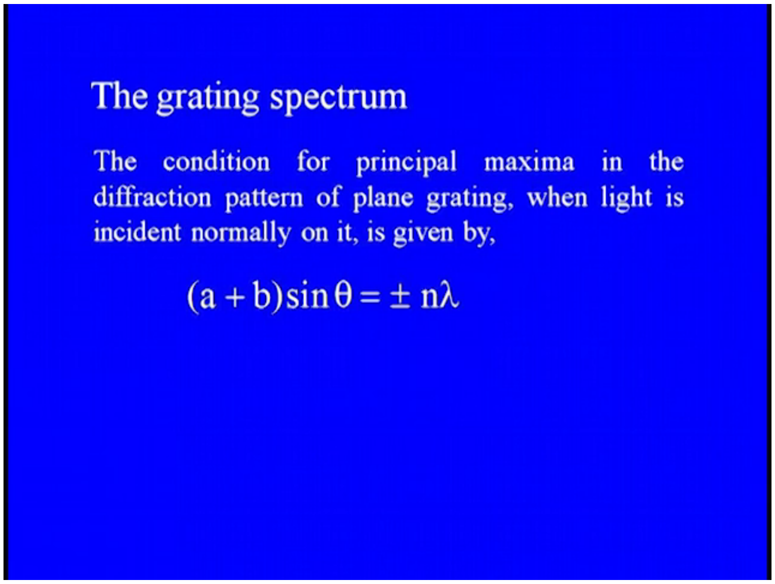

Now we will discuss about the grating spectrum. So, the condition for principal Maxima in the diffraction pattern of plane grating when light is incident normally on it is given by a + b sine theta = + - n lambda.

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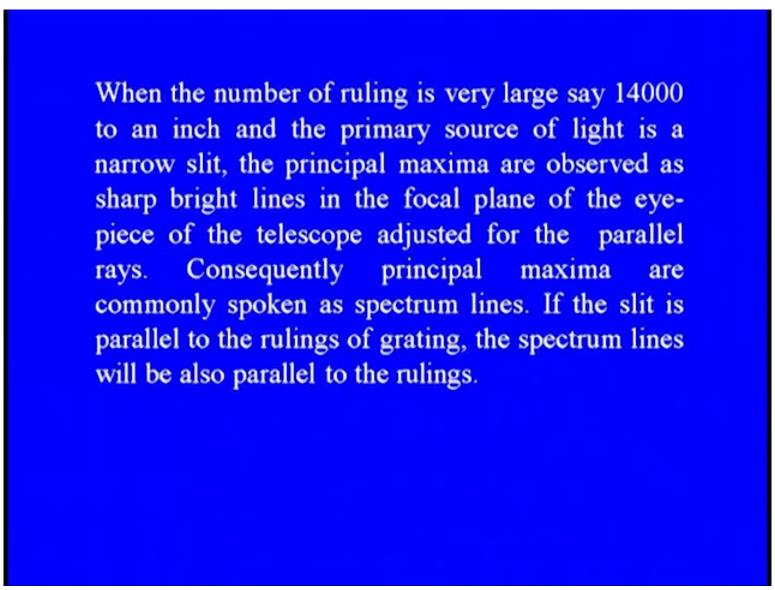

When the number of ruling is very large say 14,000to an inch and the primary source of light is a narrow slit the principal Maxima are absorbed as or bright lines in the focal plane of the eyepiece of the telescope adjusted for the parallel rays. Consequently the principal Maxima are commonly spoken as a spectrum. If the slit is parallel to the rulings of the grating the spectrum lines will be also parallel to the rulings.

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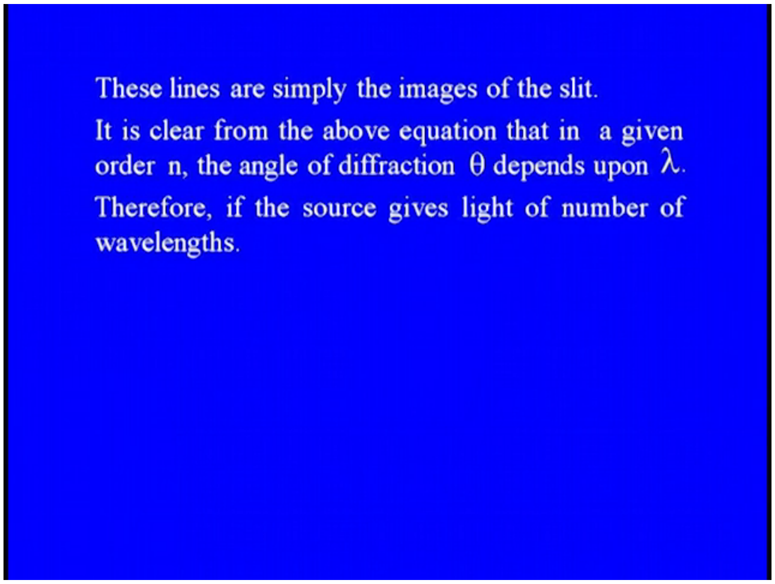

These lines are simply the images of the slit; it is clear from the above equation that in a given order n the angle of deflection theta depends upon wavelength lambda therefore if the source gives light of number of wavelengths.

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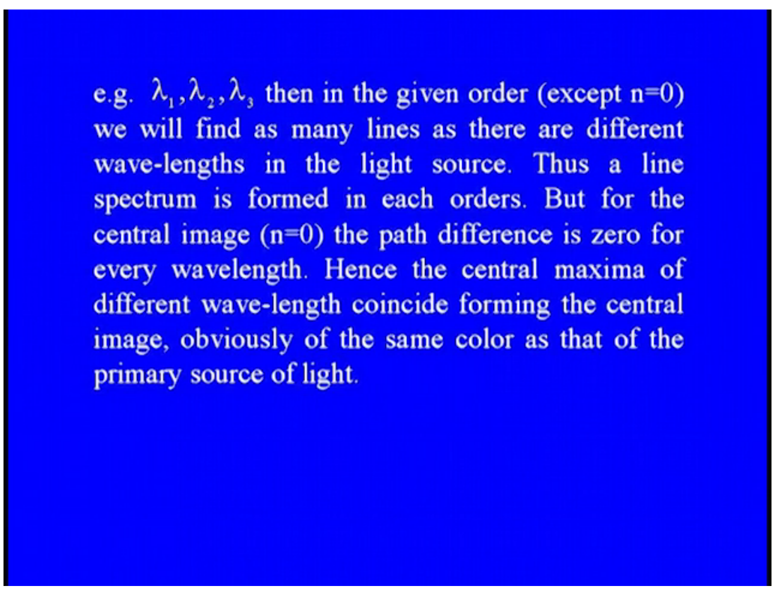

That is lambda 1, lambda 2, lambda 3 so on then in the given order except n = 0, we will find as many lines and there are different wavelengths in the light source. Thus a line spectrum is form in each order but for the central image that is for n = 0 the path difference is 0 for every wavelength. Hence the central maxima of different wavelength coincide forming the central image obviously of the same color as that of the primary source of light.

On the other side of the central image a similar set of spectra are formed in each other. The spectrum lines' corresponding to shortest wavelength is formed on the side towards the central image.

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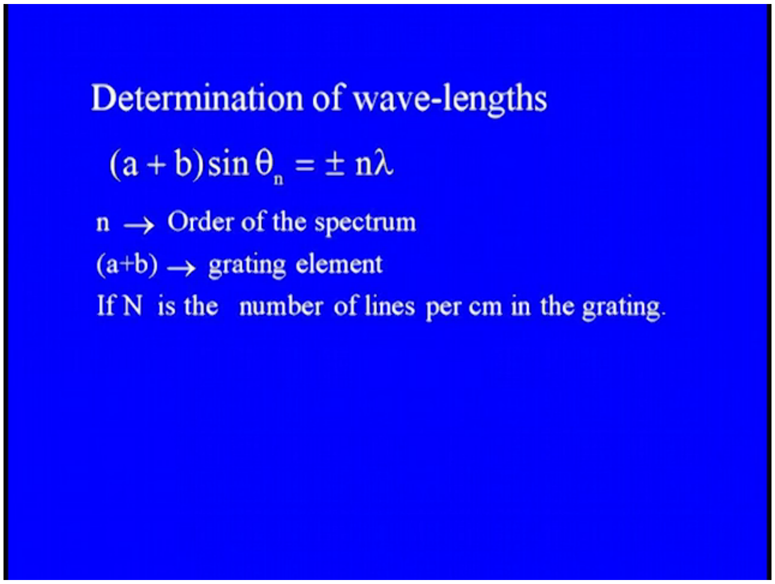

Now let us see how to determine the wavelength of light by using the grating spectrum so we have a + b sine theta n = + - n lambda, so here n is the order of the spectrum and a + b in the grating element and if capital N is the number of lines per centimeter in the grating.

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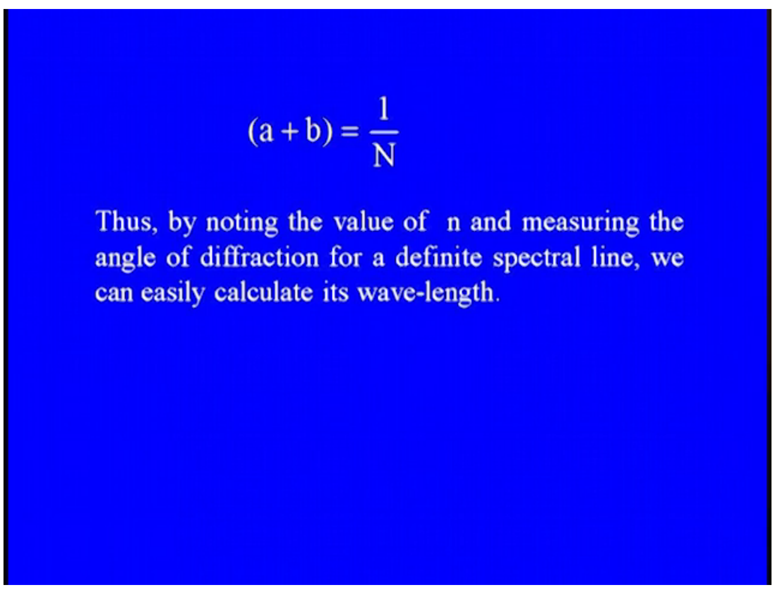

Then we can calculate a + b = 1 over capital N thus by noting the value of n that is order of the respect and measuring the angle of diffraction for a definite spectral line, we can easily calculate its wavelength. So, this angle theta is measured by using a spectrometer in the laboratory. So, to determine the value of wavelength by using grating we have to measure experimentally the deflection angle theta.

And then by knowing the order of the deflections and then using this equation a + b sine theta is = n-lambda we can calculate the value of wavelength.

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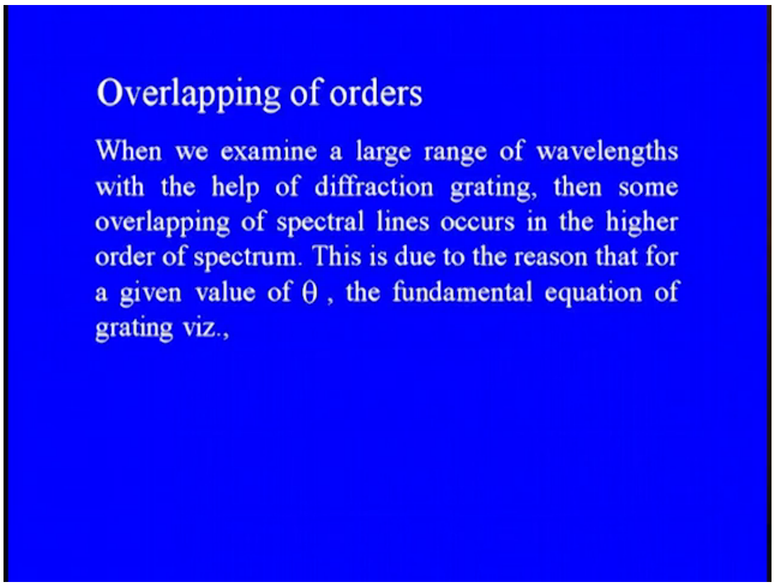

Now let us discuss about the overlapping of orders, so when we examine a large range of wavelengths with the help of diffraction grating then some overlapping of spectral lines occurs in the higher order of the spectrum. This is due to the reason that for a given value of theta the fundamental equation of grating.

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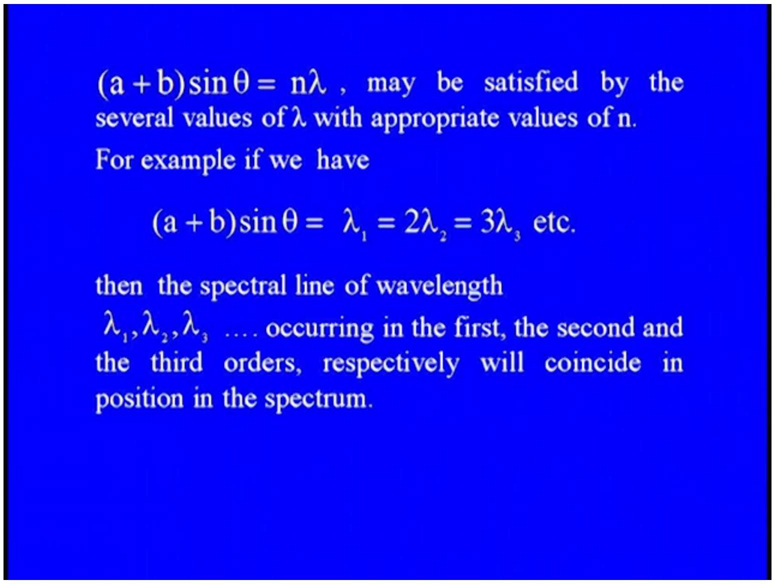

That is a + b sine theta = n lambda may be satisfied by the several values of lambda with appropriate values of n. For example if we have a + b sine theta = lambda 1 = 2 times lambda 2 = 3 times lambda 3 so on. Then the spectral line of wavelengths lambda 1, lambda 2, lambda 3 so on occurring in the first, the second and the third orders respectively will coincide in position in the spectrum that is they will overlap.

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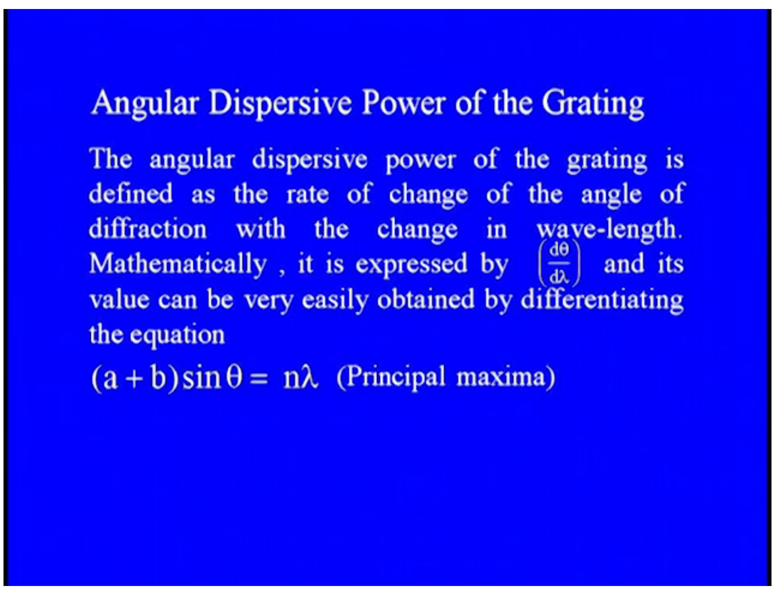

Now let us calculate the angular dispersive power of the grating the angular dispersive power of the grating is defined as the rate of change of the angle of diffraction with the change in wavelength. Mathematically it is expressed by d theta by lambda and its value can be very easily obtained by differentiating equation a + b sine theta = n lambda.

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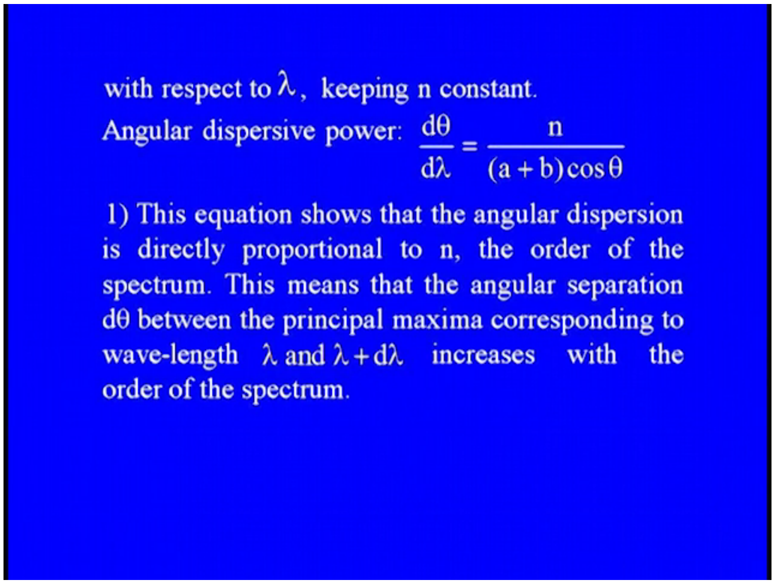

With respect to lambda keeping n constant so angular dispersive power d theta by d lambda will be = n upon a + b cos theta. So, this equation shows that the angular dispersion is directly proportional to and the order of the spectrum this means that the angular separation d theta between the principal maximum corresponding to wavelength lambda and lambda + d lambda increases with the order of the spectrum.

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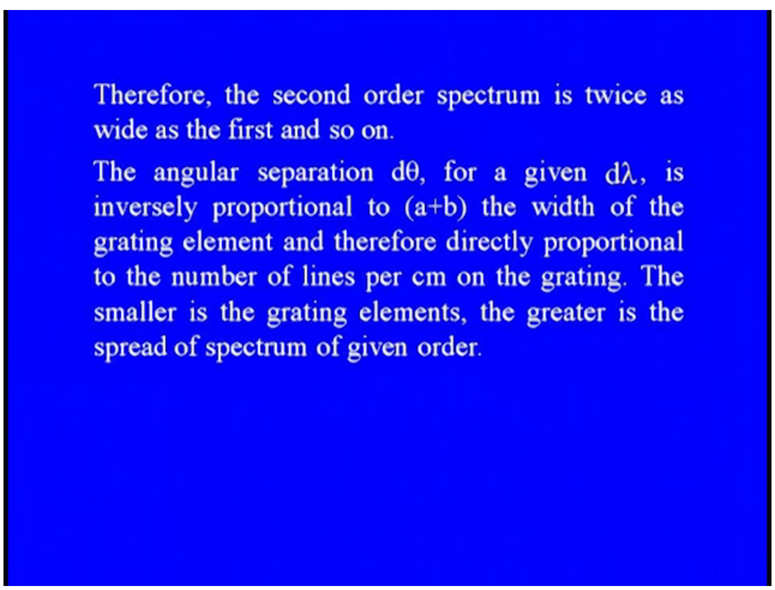

Therefore the second order spectrum is twice as wide as the first and so on the angular separation d theta for a given d lambda is inversely proportional to a + b the width of the grating element and therefore directly proportional to the number of lines per centimeter on the grating. The smaller is the grating element the greater is the spread of a spectrum of given order.

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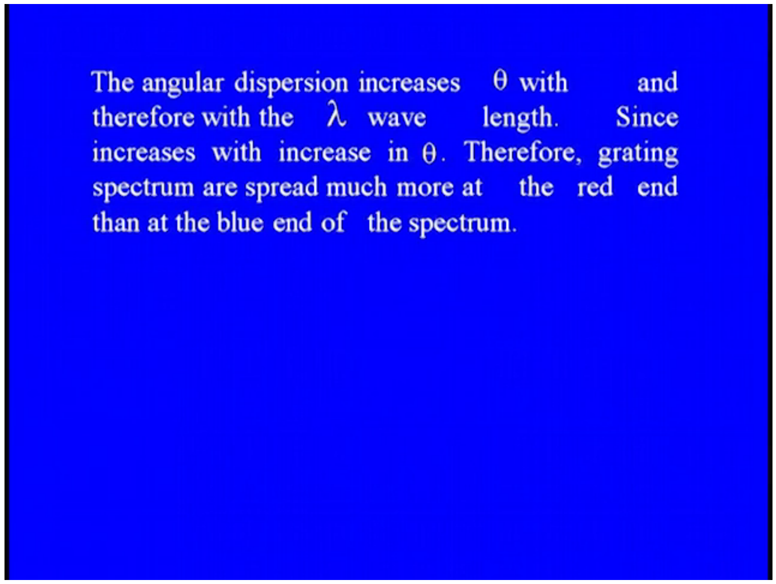

The angular dispersion increases theta and therefore with the wavelength since theta increases with increasing lambda therefore creating a spectrum are spread much more at the radiant than had the blue in of the spectrum.

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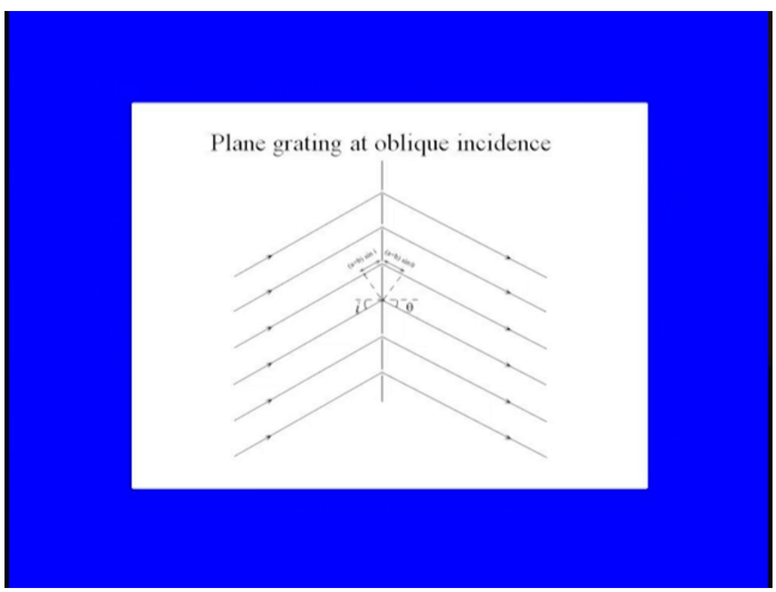

Now let us consider the plane wave front of light of wavelength lambda is incident obliquely on the grating had the angle of incidence i as shown in this figure. For a set of parallel rays deflected at an angle theta with the grating normal. It can be shown that the difference of paths of the deflected rays from the corresponding point of grating is a + b into sine i + sine theta. Therefore in this case the condition for principle Maxima becomes a + b into sine i + sine theta = L lambda. So, this is the condition for principle Maxima for oblique incidence.

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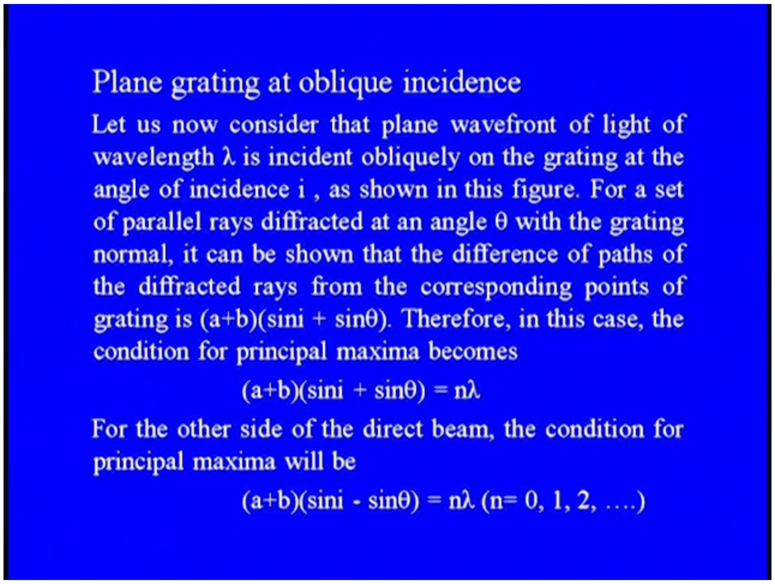

For the other side of the direct beam the condition for principle Maxima in case of oblique incidence will be a + b sine i - sine theta = n lambda where n = 0, 1, 2, 3 so on.

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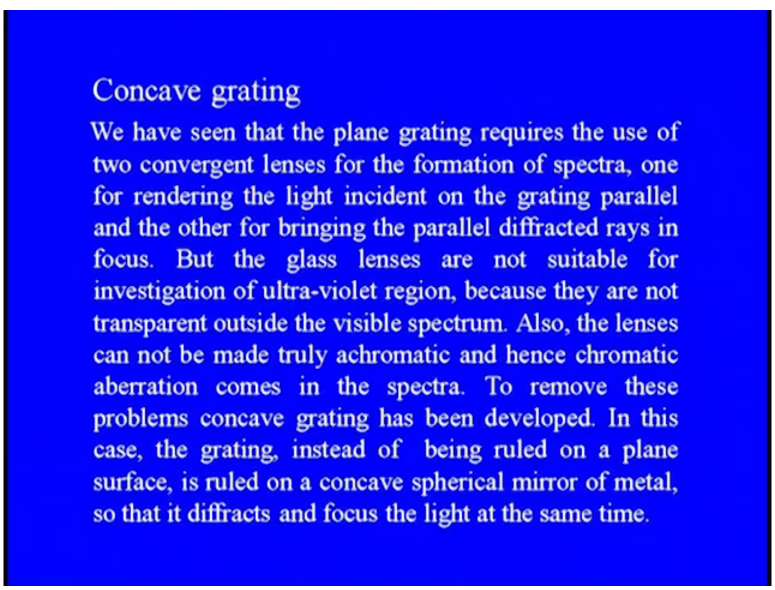

Now we will discuss briefly about the concave grating, so we have seen that the plane grating requires the use of two convergent lenses for the formation of a spectra. One for rendering the light incident on the grating parallel and the other for bringing the parallel deflected rays in focus but the glass lenses are not suitable for investigation of ultraviolet region because they are not transparent outside the visible spectrum.

Also the lenses cannot be made truly a chromatic and hence chromatic aberration comes in the spectra. To remove these problems concave grating has been developed. In this case the grating instead of being ruled on the plane surface is ruled on a concave spherical mirror of metal so that it deflects and focus the light at the same time. This will eliminate the chromatic aberration and can be used in ultraviolet region.

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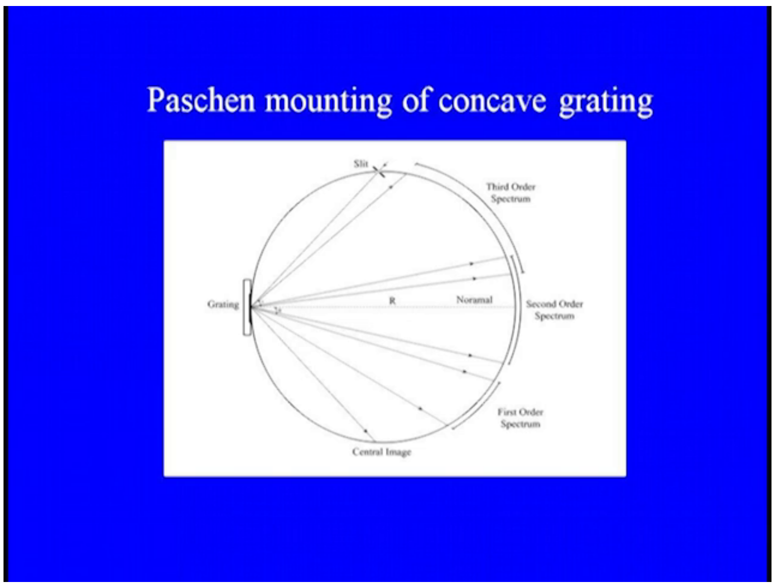

So if r is the radius of curvature of the spherical surface of the grating a circle of diameter R can be drawn tangent to the grating at its midpoint which defines the locus of points where the spectrum is in focus provided the source slit also lies on this circle as shown in this figure. This circle is called the Ronald circle and the mounting is known as Paschen mounting. So, till now we have discussed single slit, double slit and multiple slit diffraction pattern.

Now I am going to discuss about the resolving power of certain instrument like grating telescope and microscopes. So, let us first discuss how the diffraction phenomena limit the resolving power of the instruments.

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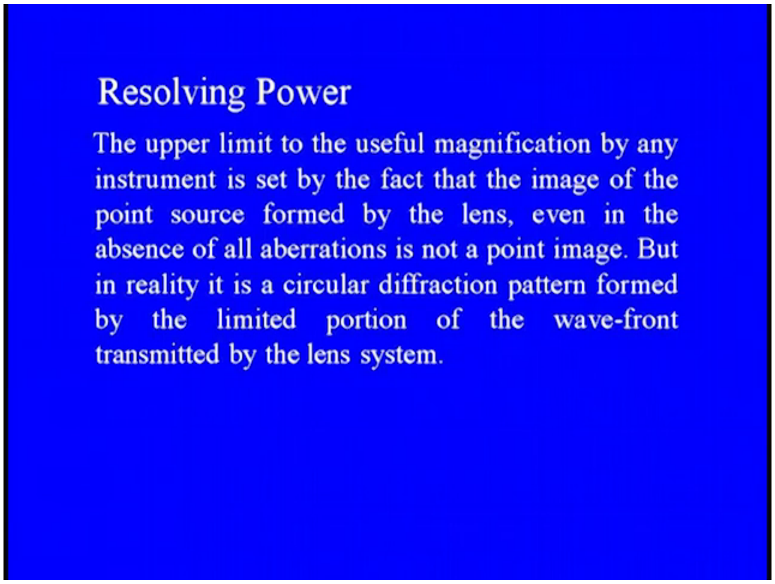

So, the upper limit to the useful magnification by an any instrument is set by the fact that the image of the point source formed by the lens even in the absence of all of aberrations is not a point image. But in reality it is a circular diffraction pattern formed by the limited portion of the wave front transmitted by the lens system.

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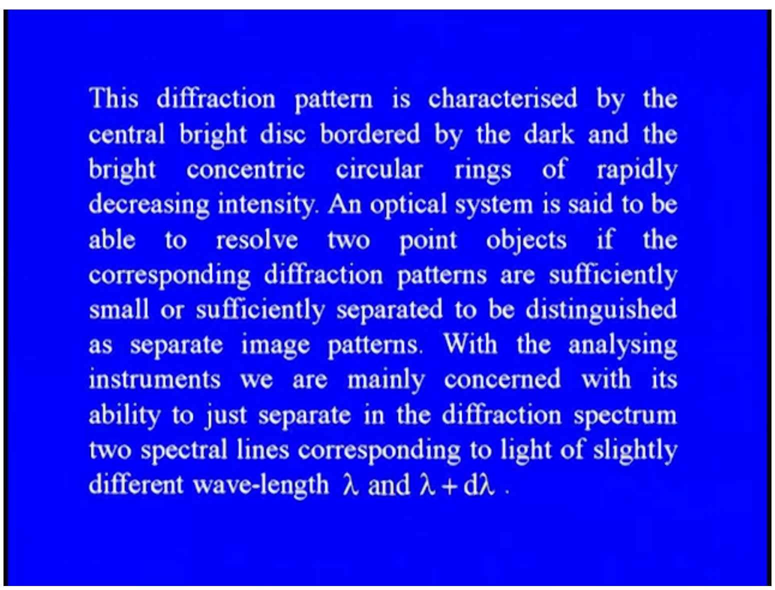

This diffraction pattern is characterized by the central bright disc bordered by the dark and the bright concentric circular rings of rapidly decreasing intensity. An optical system is said to be able to resolve two point objects if the corresponding diffraction patterns are sufficiently small or sufficiently separated to be distinguished as separate image patterns.

With the analyzing instruments we are mainly concerned with its ability to just separate in the deflection spectrum to spectral lines corresponding to light of is slightly different wavelengths lambda and lambda +d lambda.

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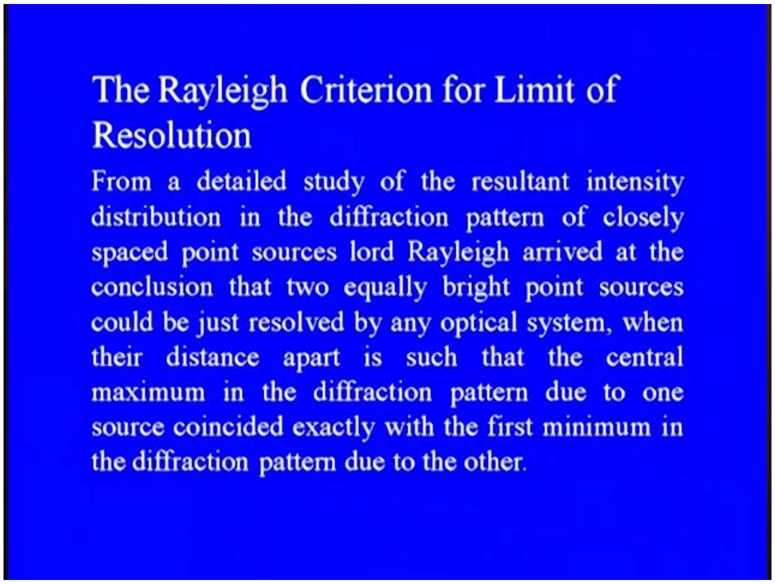

Now let us discuss about the Rayleigh Criteria for the limit of resolutions. From a detailed study of the resultant intensity distribution in the diffraction pattern of closely spaced point sources Lord Rayleigh arrived at the conclusion that two equally bright point sources could be just resolved by any optical system when the earth distance if apart is such that the central maximum in the diffraction pattern due to one source coincided exactly with the first minimum in the diffraction pattern due to the other.

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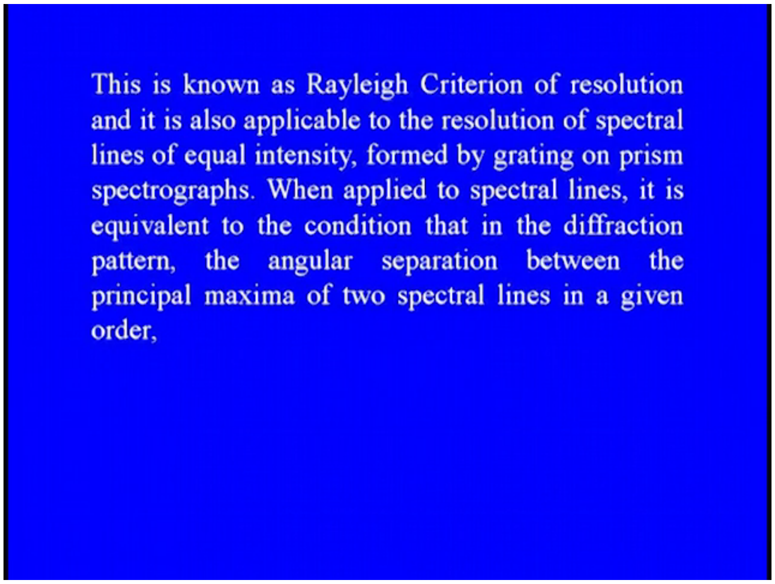

This is known as Rayleigh Criterion of resolution and it is also applicable to the resolution of spectral lines of equal intensity formed by grating on the bridge a spectrograph. When applied to a spectral lines it is equivalent to the condition that in the diffraction pattern the angular separation between the principal Maxima of two spectral lines in a given order.

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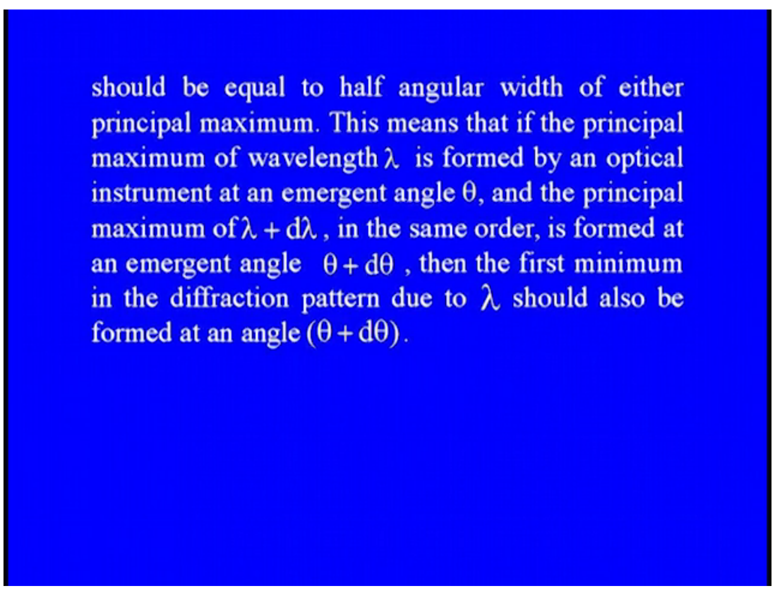

Should be = half angular width of either principal maximum, this means that if the principal maximum of wavelength lambda is formed by an optical instrument at and emergent angle theta and the principal maximum of lambda + d lambda in the same order is formed an emergent angle theta + d theta. Then the first minimum in the diffraction pattern due to lambda should also be formed at an angle theta + d theta.

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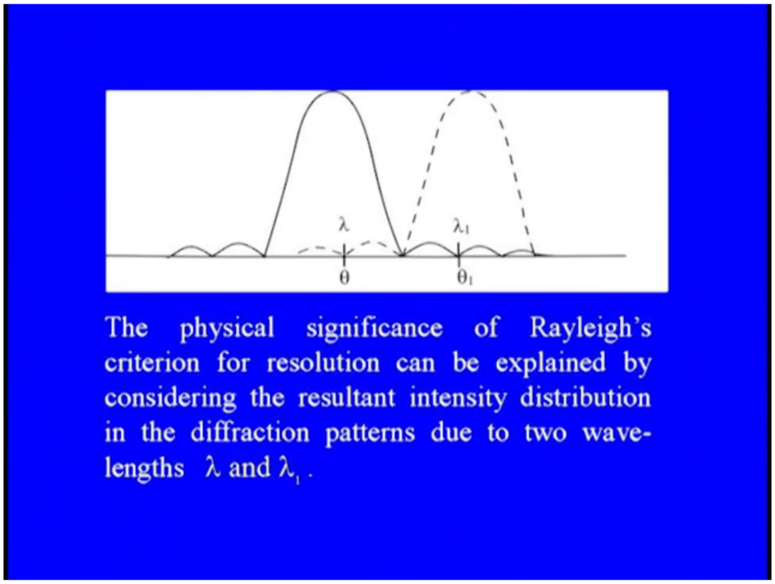

The physical significance of Raleigh's criteria for resolution can be explained by considering the resultant intensity distribution in the diffraction pattern due to two wavelengths lambda and lambda 1.

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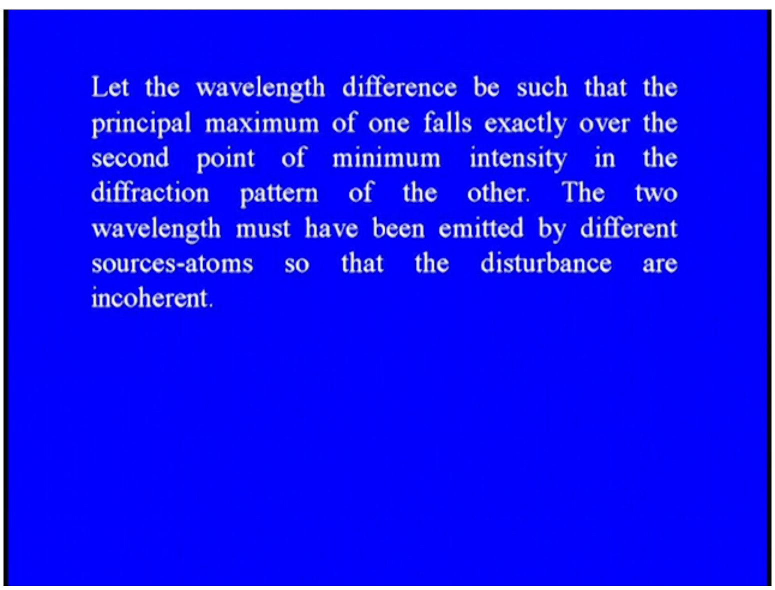

Let the wavelength difference be such that the principal Maxima of one falls exactly over the second point of minimum intensity in the diffraction pattern of other. The two wavelengths must have been emitted by different sources so that the disturbances are incoherent.

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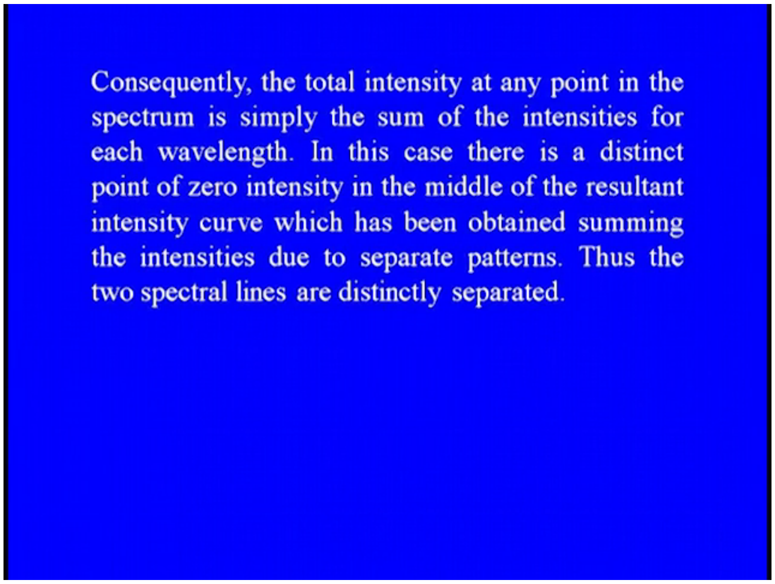

Consequently the total intensity at any point in the spectrum is simply the sum of the intensities for each wavelength. In this case there is a distinct point of 0 intensity in the middle of the resultant intensity curve which has been obtained summing the intensities due to separate pattern thus the two spectral lines are distinctly separated.

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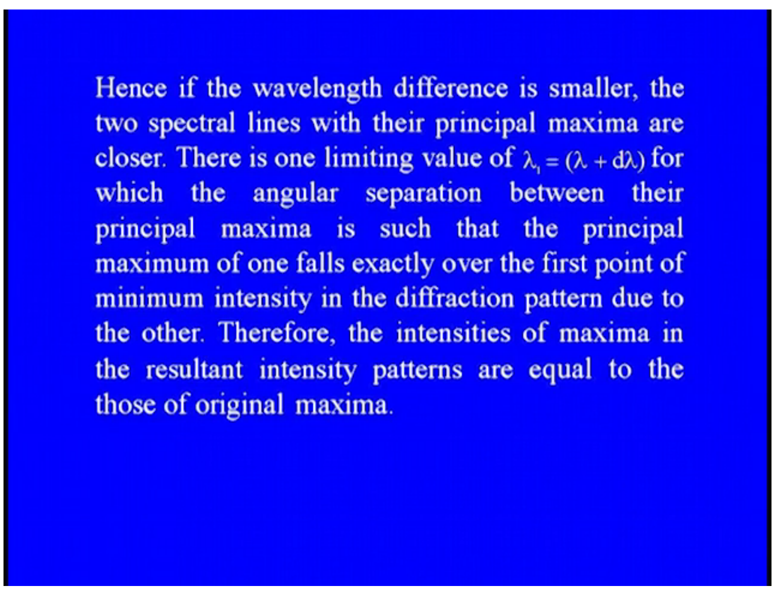

Hence if the wavelength difference is smaller the two spectral lines with their principal Maxima are closer. There is one limiting value of lambda 1 = lambda + d lambda for which the angular separation between their principal Maxima is such that the principal maximum of one falls exactly over the first point of minimum intensity in the diffraction pattern due to the other.

Therefore the intensities of Maxima in the resultant intensity patterns are = the those of original Maxima.

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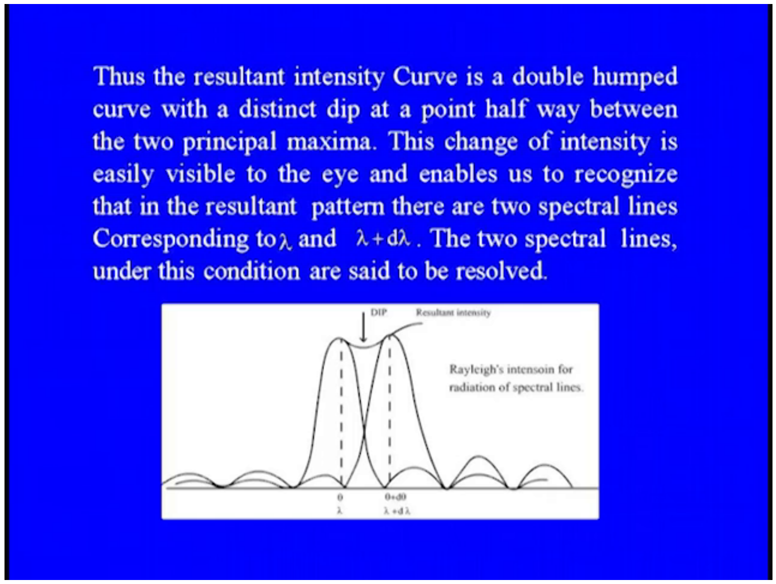

hus the resultant intensity curve is a double humped curve with a distinct dip at a point half way between the two principal Maxima. This change of intensity is easily visible to the eye and enables us to recognize that in the resultant pattern there are two spectral lines corresponding to lambda and lambda + d lambda. The two spectral lines under this condition are said to be resolved.

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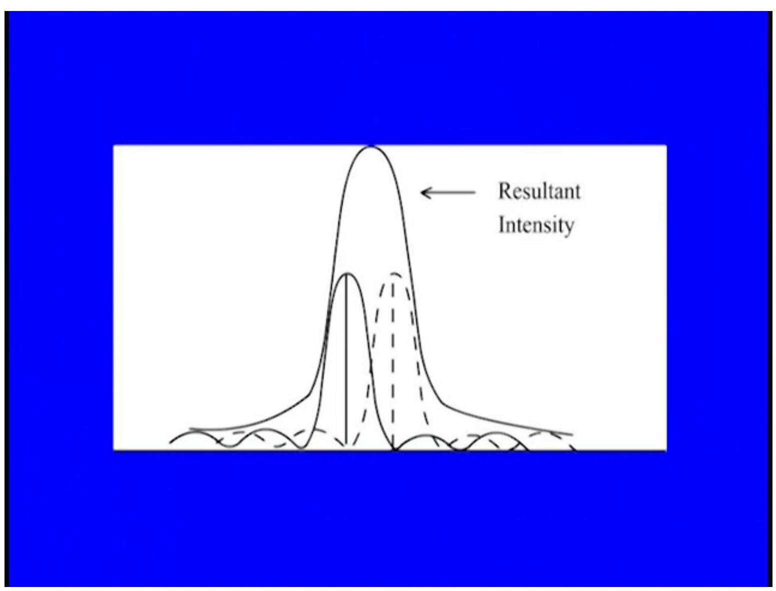

But if lambda 1 is less than lambda + d lambda the two spectral lines come little closer and the intensity curves of the principal maxima so considerable overlapping. The resultant intensity curve exhibits no dip but only one maximum in the center. Thereby indicating as if it is a diffraction pattern of only one spectral line thus under this condition the two spectral lines are not resolved in their diffraction pattern.

Hence for two spectral lines to be resolved it is absolutely essential that the leashed angular separation between their principal Maxima should be such that the principal maximum of one should fall on the first point of minimum intensity of the other. Now let us use this Rayleigh Criteria to derive the expression for resolving power of a grating.

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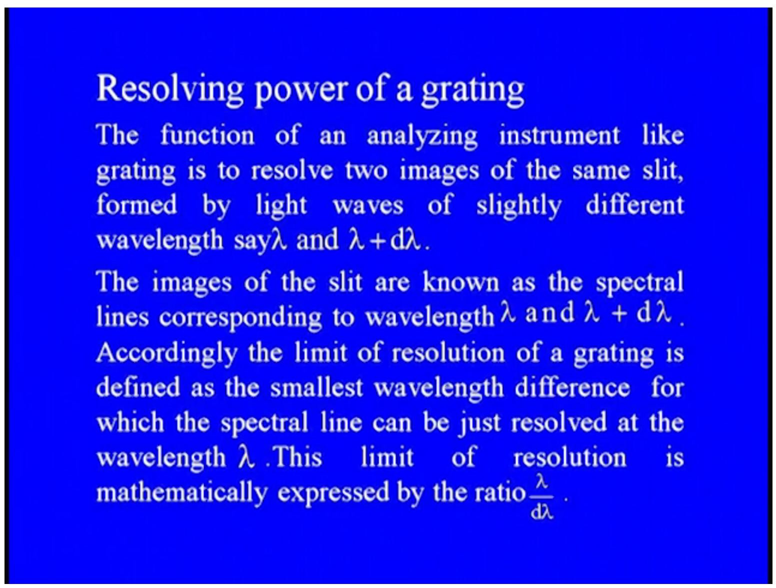

The function of an analyzing instrument like grating is to resolve two images of the same slit formed by light waves of slightly different wavelengths say lambda and lambda + d lambda. The images of the slit are known as the spectral lines corresponding to wavelength lambda and lambda + d lambda. Accordingly the limit of resolution of a grating is defined as the smallest wavelength difference for which the spectral line can be just resolved at the wavelength lambda. This limit of resolution is mathematically expressed by the ratio lambda to d lambda.

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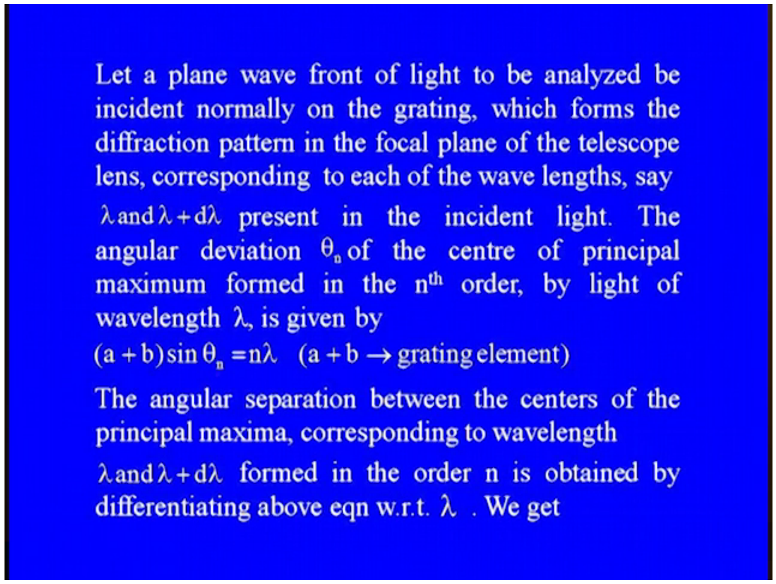

Now let a plane wave front of light to be analyzed be incident normally on the grating which forms the diffraction pattern in the focal plane of the telescope lens corresponding to each of the wavelengths say lambda and lambda + d lambda present in the incident light. The angular deviation theta n of the center of principle maximum formed in the nth order by light of wavelength lambda is given by a + b sine theta n = n lambda where a + b is the grating element.

The angular separation between the centers of the principal maxima corresponding to wavelength lambda and lambda + d lambda formed in the order n is obtained by differentiating above equation with respect to lambda.

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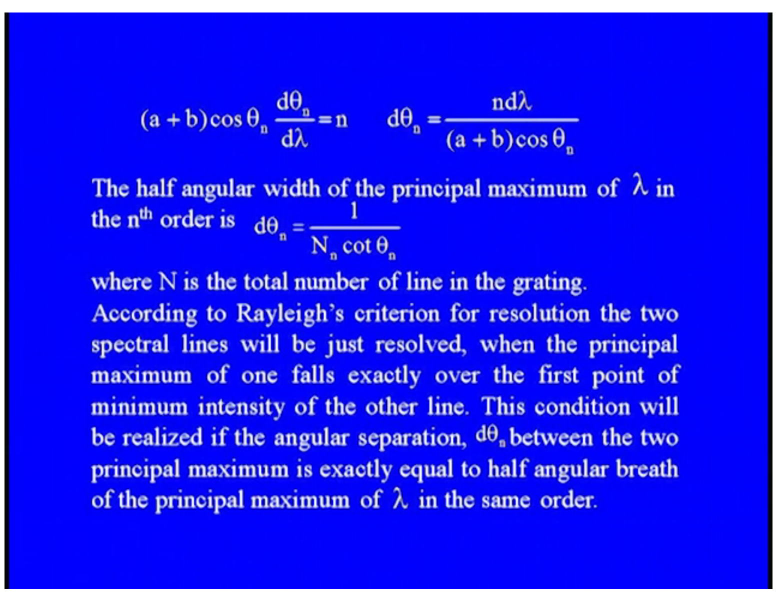

So, we get a + b cos theta n d theta n by d lambda = n or d theta n =nd lambda divided by a + b cos theta n. The half angular width of the principal maximum of lambda in the nth at order is therefore d theta n = 1 over n into N cot theta and where capital N is the total number of lines in the grating. Now according to the Reyleigh's criterion for resolution the two spectral lines will be just resolved when the principal maximum of one falls exactly over the first point of minimum intensity of the other line.

This condition will be realized if the angular separation d theta n between the two principal maximum is exactly = half angular breadth of the principal maximum of lambda in the same order.

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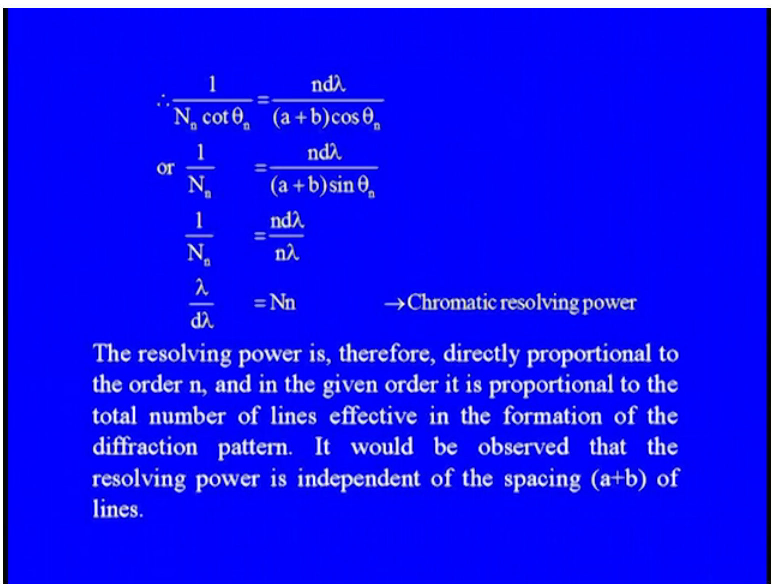

So, 1 over n capital N into small n cot theta n should be = n d lambda upon a + b cos theta n with the help of this equation we can write lambda upon d lambda = capital N times n which is known as the chromatic resolving power of grating. So, the resolving power is directly proportional to the order n and in the given order it is proportional to the total number of lines effective in the formation of diffraction pattern. It should be observed that the resolving power is independent of the spacing a + b of lines.

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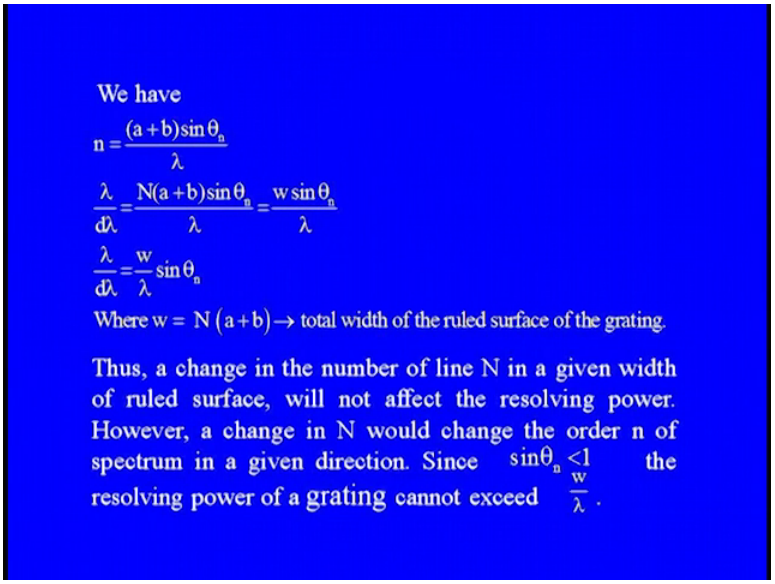

We have small n = a + b sine theta n by lambda so we can also write the resolving power lambda upon d lambda = capital N times a + b sine theta n upon lambda which we can write = W sine theta n by lambda where W is = n capital N times a + b which is the total width of the ruled surface of the grating. Thus a change in the number of lines capital N in a given width of ruled surface will not affect the resolving power.

However a change in capital N would change the order n of the spectrum in a given directions. Since sine theta n is less than 1 the resolving power of a grating cannot exceed W by lambda.

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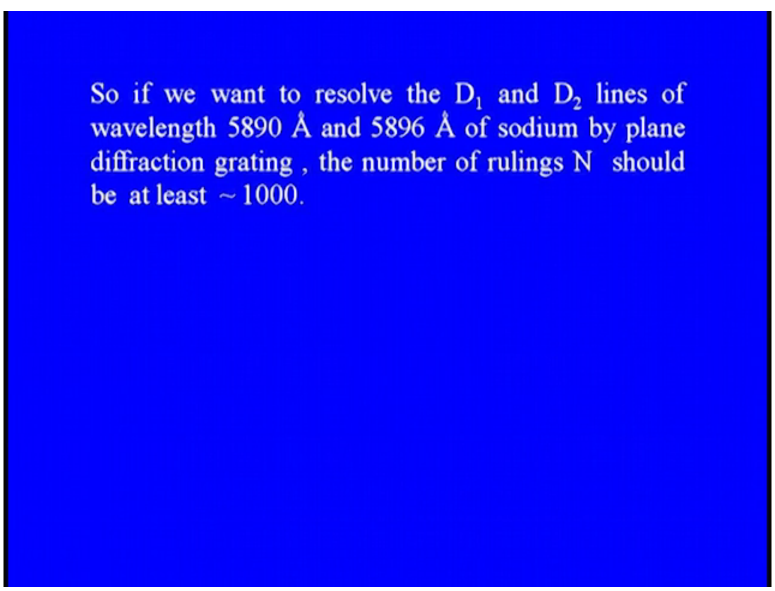

So, if we have to resolve the D1 and D2 lines of wavelength 5890 angstrom and 5896 angstrom of sodium by plane diffraction grating the number of ruling N should be at least of the order of thousands. Now let us calculate the resolving power of a microscope so the primary function of a microscope is not to magnify an object but to reveal those finer details in the object which are invisible to and had an eye.

They extend to which finer details are revealed depends on depends not on the magnifying power but on the resolving power of the microscope the resolving power of a microscope is conveniently expressed in terms of the smallest linear separation between two points object which are just resolved. That is their diffraction patterns formed by the microscope objective are just distinguishable.

The smaller is this distance the greater is said to be resolving power. Let us derive this list separation between the two point object for two distinct cases. Number one the object or self luminous having no phase relation, number two objects are not non luminous but their illumination is coherent. So, let me summarize what I have discussed in this lectures so in this lecture I discussed that if refraction pattern of n slit.

And I discuss how to use grating spectrum to calculate the wavelength of light in the laboratory and then I discussed the Rayleigh criteria for resolution and derive the expression for resolving power of grating. In the left next lecture I will discuss about the resolving power of microscope and telescope and I will also solve some numerical problem related to single slit double slit and multiple slit Fraunhofer diffraction, thank you.