Wave Optics IIT AND JEE Important Formula

The path difference of two coherent Waves

The two waves have a complete wavelength's value of separation between them. Hence, the path difference is 1λ . A crest encounters another crest when the path difference is one complete wavelength, which causes constructive interference.

$\Delta d = d_2 - d_1$

Δd is the path difference

The Path difference of two coherent waves: Interference Maximum

$\Delta d = k.\lambda$

Δd is path difference

Λ is the wave length

The path difference of two coherent waves: Interference Minimum

$\Delta d = \frac{(2.k+1).\lambda}{2}$

Δd is path difference

Λ is the wave length

Thin-film interference: Constructive (maximum)

In our daily lives, thin-film interference is a frequent occurrence. For instance, you probably noticed a rainbow-colored reflection in a bubble or in a water pool on the side of the road. Thin-film interference is the term for this visible effect.

$2.h.n.\cos(\beta) = \frac{(2.k+1).\lambda}{2}$

h is film thickness

n is refractive index

β is refraction angle

λ is wave length

Thin-Film interference: destructive (minimum)

$2.h.n.\cos(\beta) = \lambda.k$

h is film thickness

n is refractive index

β is refraction angle

λ is wave length

Radii of Newton's Ring

An optical phenomenon known as a Ring of Newton's occurs when a convex piece of glass sits on a flat piece of glass, producing a ring of dark-coloured lights or bands. As a result, there is an air-filled area between them. This phenomena is thought to be caused by interference between light waves, which causes light to brighten when their crests line up but dim when they cross.

$r = \sqrt{k.R.\lambda}$ or $r = \frac{\sqrt{((2.k+1).R.\lambda)}}{2}$

r is the radius

R is the radius of curvature

λ is the wavelength

Light Diffraction

The act of bending light around corners such that it spreads out and illuminates regions where a shadow is anticipated is known as diffraction of light. The diffraction of light is what causes the silver lining we see in the sky.

$l = \frac{d^2}{4.\lambda}$

I is the distance from obstacle

d is the obstacle size

λ is wavelength

Diffraction grating: maximum (bright stripes)

A diffraction grating is an optical component that separates (disperse) light made up of a variety of wavelengths (such as white light) into its individual wavelength components. The most basic kind of grating has a lot of parallel slits that are widely separated from one another. The light components of white light that enters the grating are diffracted at angles dictated by their respective wavelengths (diffraction).

$d.\sin(\phi) = k.\lambda$

d is the lattice constant

ϕ is the diffraction angle

λ is the wavelength

Diffraction grating (dark stripes)

$d.\sin(\phi) = \frac{(2.k+1).\lambda}{2}$

d is the lattice constant

ϕ is the diffraction angle

λ is the wavelength