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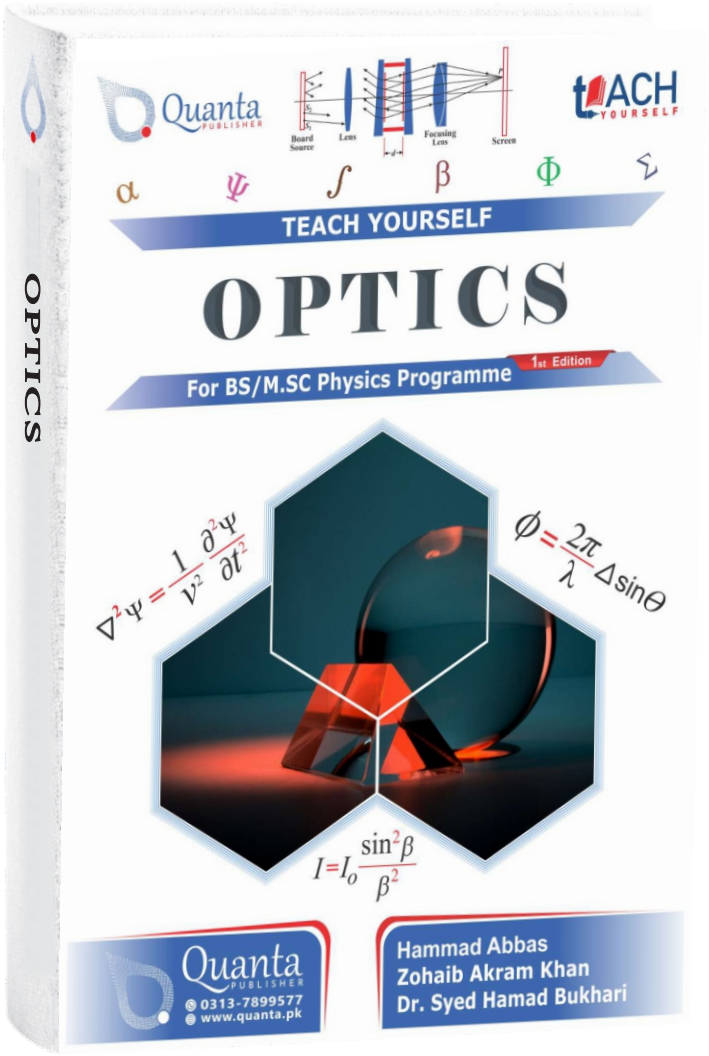

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Contents

Chapter 1

Introduction to Optics

1.1 History of Optics

Optics is the study of light that has always fascinated humans. It also deals with behavior of light through lenes mirrors. Although optics now modernized but there is history behind this.

In the beginning

The origin of optics will be found in 1200 BCE. At that eras specimen have been found from ancient Egypt, a mirror was found in imperfect condition early mirror were made of polished copper, bronze and speculum (a copper alloy with tin). The Greek philosopher developed theories about light. We now introduce some scientists who developed fundamental of optics.

Arcyhtas a Greek philosopher proposed the idea that vision aries as effect of an invisible fire emitted from the eye so that on encountering objects it may reveal their shape and colors.

Euclid proposed that light travel in straight line and describe law of reflection. The rectilinear propagation of light. He believed vision involves rays going from eyes to objects seen.

Hero of Alexandria wrote catoplrica which describe the propagation of light reflection and use of mirror.

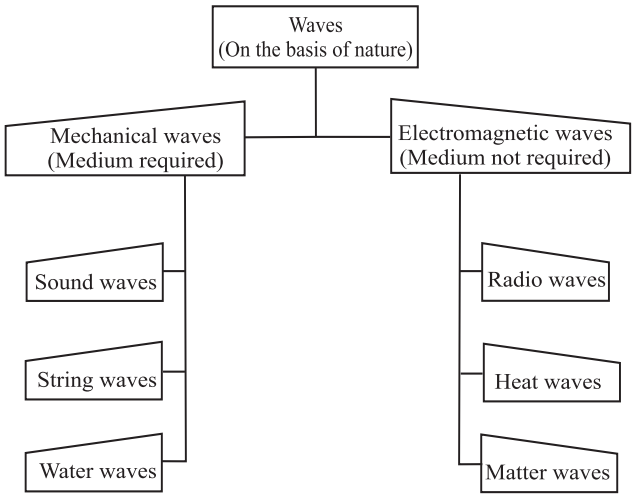
Seneca the Roman philosopher observe that glass globe fill with water used for magnifying purpose.

Chapter 2

Wave Motion

2.1 Waves

A traveling disturbance that carries energy through matter and space is called wave. Wave transfer energy and momentum from one place to another place without transferring matter is called wave motion. e.g. sound energy and light energy.



Types of Wave

There are two types of wave.

1. Electromagnetic Waves
2. Mechanical Waves

Chapter 3

Maxwell Equations in Free Space

The simplest statement of Maxwell's equations applies to the behavior of electric and magnetic fields in free space where $\varepsilon = \varepsilon_\circ$ and $\mu = \mu_\circ$, are electrical and magnetic constants.

3.1 Maxwell Equations

Maxwell unified the theories of electricity and magnetism by way of deducing four very important equations which combine the experimental observations reported by Gauss, Ampere and Faraday with his concept of displacement current. The equations encapsulated the connection between the electric field and electric charge and between the magnetic field and electric current. The Maxwell's equations also define the bilateral coupling between the electric magnetic field quantities. They along with some supportive equations form the fundamental principle of electromagnetic theory. When the charge and current source vary with time, the electric and magnetic fields become interconnected and the coupling between them produces electromagnetic waves capable of traveling through free space and in material media. In all, there are four Maxwell's equations. These equations derived since they are the fundamental axioms or postulates of electrodynamics, obtained help of generalization of experimental results. The Maxwell's equations are expressed in differential form and integral form in the following way:

Chapter 4

Polarization

4.1 Hero's Variational Principle

Hero of Alexandria (150BC-250AD), was the first who proposed the variational principle, which is stated as follows: "the path actually taken by light in going from some point S to a point P via reflecting surface was the shortest possible one" as shown in Fig.(4.1). Consider a point source S emitting a number of rays which are then reflected toward P. Presumably only one of these paths will have any physical reality. S' is the image of S. If we simply draw the rays as if they emanated from S', Fig.(4.1) of the distances to P will have beam altered i.e.

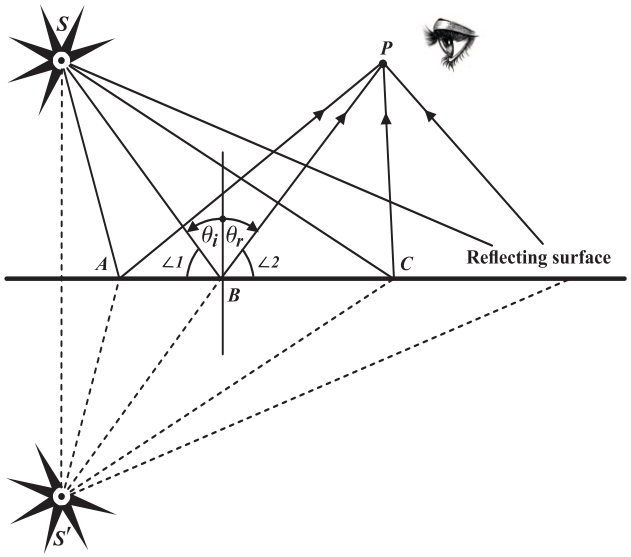


Fig. 4.1. Minimum path from source S to the observer eye at P.

Chapter 5

Wavefront Splitting Interferometer

5.1 Young's Double Slit Experiment

Young's double slit experiment uses two coherent source of light placed at a small distance apart, usually only a few orders of magnitude greater than the wavelength of light is used.

Experimental Setup

Young in 1801, for studying **Interference**, effects of light, screen having 2 slits is illuminated by a beam of monochromatic light. The portion of the wave front incident on the slits behaves as a source of secondary wavelets (Huygens's principle). The secondary wavelets leaving slits are coherent superpositions of slits of the wavelets result in a series of bright and dark fringes which are observed on a second screen placed at some parallel screen.

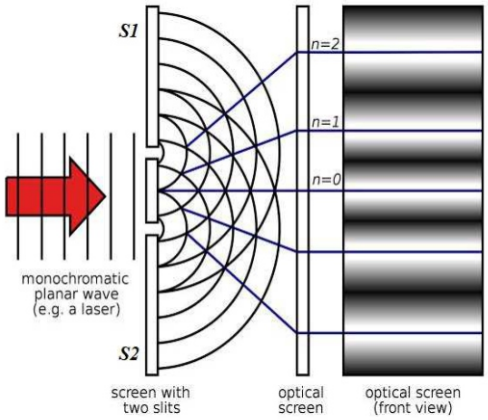


Fig. 5.1. Interference pattern when a monochromatic light passes through two slits.

Chapter 6

Introduction To Diffraction

Consider a plane wave incident on a long narrow slit of width in Fig.(6.1) .According to geometrical optics one expects the region AB of the screen SS' to be illuminated and the remaining portion (known as the geometrical shadow) to be absolutely dark. However, if the observation are made careful then one finds that if the width of the slit is not very large compared to the wavelength, then the light intensity in the region AB is not uniform and there is also some intensity inside the geometrical shadow. Further , if width of the slit is made smaller, larger amounts of energy reach the geometrical shadow. This spreading out of a wave when it passes, is shown in Fig.(6.1).

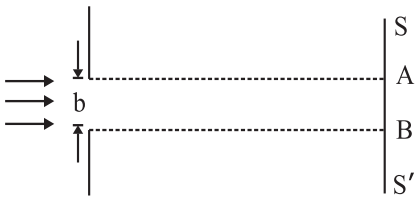


Fig. 6.1. Single slit diffraction.

If a plane wave is incident on an aperture then according to geometrical optics a sharp shadow will be cast in the region AB of the screen through a narrow opening is usually referred to as diffraction and the intensity distribution on the screen is known as the diffraction pattern. We will discuss the phenomena of diffraction in this chapter and will show that the spreading out decrease with decrease in wavelength. Indeed, since the light wavelengths are very small ($\lambda \sim 5 \times 10^{-5} cm$), the effect due to diffraction are not readily observed.

Chapter 7

Matrix Method in Paraxial Optics

The subject of geometrical optics concerns with the analysis of propagation of light in a medium by considering it as the propagation of ray. A ray defuses a path along which light Propagates propagates. A ray is an infinitesimally thin pencil of light moving in a certain direction at a given point in a medium. A bundle or infinitely large number of parallel rays constitute a beam of light. In contrast, the wave optics, light propagation is described by a wave equation.

Paraxial Ray

Rays of light close to the optical axis of the system under these conditions, the angle of incidence are small. so the sines and tangents of angles can be replaced by angles expressed in radian.

Laws of Refraction

↬ The incident ray, the refracted ray and the normal lie in the same plane

↬ If θ_1 and θ_2 represent the angles of incident and refracted respectively, then $n_1 \sin\theta_1 = n_2 \sin\theta_2$.

Optical system in general are made up of a large number of refracting surfaces (like a combination of lenses) and any ray can be traced through the system by using laws of refraction. In order to obtain the position of the final image due to such a system, one has to calculate step by step the position of the image due to each surface and this image will act as an object for the next surface. Such a step by step analysis becomes complicated as the number of elements of an optical system increases. Instead of using laws of refraction to the optical system, matrix method can be applied with ease for

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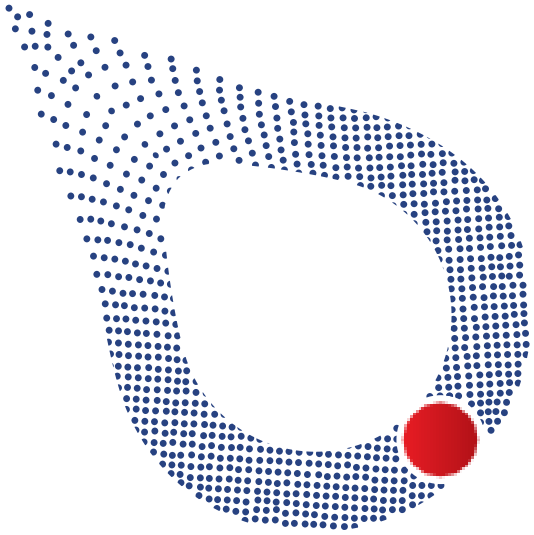

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