



# WAVE OPTICS

## PROF. SAMUDRA ROY

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IIT Kharagpur

### PRE-REQUISITES :

1. Basic Electrodynamics
2. Elementary Mathematics

**INTENDED AUDIENCE :** B.Sc, B.Tech, B.Ed.

### COURSE OUTLINE :

The course offers a profound understanding of the wave nature of light. This self-contained course begins with useful preliminaries related to the wave propagation and electromagnetic theory of light. Then the fundamental concept of various phenomenon like diffraction, interference and polarization will be developed gradually from scratch with detailed mathematical derivation. The course will be useful for UG students studying Physics.

### ABOUT INSTRUCTOR :

Prof. Samudra Roy completed his PhD from CGCRI-Kolkata (a CSIR Lab) in 2009 and carried out his post-doctoral research in Hokkaido University, Japan and Max Planck Institute for the Science of Light, Germany during 2009- 2013. He joined in the Physics Department, IIT-Kharagpur as an assistant professor in 2013 and currently hold the position of associate professor. The research field of Prof. Roy includes nonlinear photonics and light-matter interactions.

### COURSE PLAN :

**Week 1:** Basics concepts: Wave propagation, Wave equation and its solution, Maxwell's wave equation, Plane wave solution, Spherical and cylindrical waves-a full mathematical descriptions.

**Week 2:** Superposition of waves, Standing and propagation waves, Superposition of waves with different frequency: Beat formation, Concept of wave-packet, group and phase velocity

**Week 3:** Material Dispersion, Group delay, Concept of coherence: Temporal and Spatial, Light interference, outline of double slit experiment, Amplitude splitting interference

**Week 4:** Multiple beam interference, Michelson interferometer, Fabry-Perot interferometer, Newton's Rings

**Week 5:** Diffraction of light, The Huygens-Fresnel Principle, Kirchhoff's diffraction theory, Fraunhofer and Fresnel type diffraction

**Week 6:** Diffraction calculations: Single slit, Double slits, multiple slits, Rectangular aperture

**Week 7:** Diffraction from circular aperture, Airy disc, Resolving power of different instruments.

**Week 8:** Fresnel Diffraction: Fresnel half period zones, Circular aperture and Vibration spiral, Straight slit, Fresnel's integrals and Cornu spiral. Fresnel diffraction at a straight edge.

**Week 9:** Concept of polarization: Linear, circular and elliptic polarization, Polarisation by reflection and refraction, Polarisation of scattered light.

**Week 10:** Malus's Law, Dichroic polarisers. Birefringence, Uniaxial and Biaxial crystals, O-ray and E-ray

**Week 11:** Velocity ellipsoids, Nicol prism, Babinet's Compensator, Optical activity.

**Week 12:** Mathematical Description of polarization: The Stokes parameter, Jones matrix formalism and problems. Practical applications of the wave optics