APPLIED OPTICS

PROF. AKHILESH KUMAR MISHRA

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PRE-REQUISITES : Any 12 (in science stream) pass student can do this course. There are no prerequisite courses.
INTENDED AUDIENCE : Undergraduate students.
INDUSTRY SUPPORT : All of the optics related industries such as Sterlite Technologies Limited, Finolex Cables Limited etc.

COURSE OUTLINE :

This course provides an extensive exposure to the basics of classical optics. The course, in particular, discusses interference, diffraction, polarization, birefringence and optical activity and their applications in engineering in great detail. In addition, the basics of holography and lasers are also introduced.

ABOUT INSTRUCTOR :

Prof. Akhilesh Kumar Mishra received Ph.D. in Physics from IIT Delhi. During doctorate, he studied nonlinear propagation dynamics of ultrashort pulses in fibers and metamaterials. Subsequently he moved to Technion- Israel Institute of Technology, Israel, where he worked on light-matter interaction in semiconductor devices and later he shifted to Nanyang Technological University, Singapore, where he studied THz pulse generation in layered media using Inverse Spin Hall Effect. From Nov 2018 onward, Akhilesh Kumar Mishra is working as assistant professor in the Department of Physics at IIT Roorkee. His research interests include structured beams and pulses, ultra-fast dynamics in semiconductor devices, optical metamaterials, quantum optics and plasmonic sensors.

COURSE PLAN :

Week 1: Introduction of geometrical optics and ray theory, Fermat's principle, refraction from single and double interfaces

Week 2: Matrix method in paraxial optics, thick and thin lenses, unit planes, nodal planes, system of thin lenses

Week 3: Concept of wavefront, Huygens' principle and its applications, superposition of waves, introduction to polarization, linear, circular and elliptical polarizations

Week 4: Interference of light waves, Young's double slit experiment, interference of polarized light, interference with white light, displacement of fringes, Fresnel's biprism

Week 5: Interference by division of amplitude, thin parallel films, wedge shaped films, Newton's rings, Michelson interferometer and its applications

Week 6: Multiple beam interference, Fabry–Pérot interferometer and etalon, concept of coherence

Week 7: Introduction to diffraction, Fraunhofer diffraction, single, double and multiple slit diffraction

Week 8: Diffraction at a rectangular and circular apertures, diffraction grating, grating spectrum and resolving power, Fresnel diffraction

Week 9: Fresnel half period zones, vibration curve, circular obstacle, zone plates, rectangular aperture, diffraction of a plane wave by a long narrow slit and transition to Fraunhofer region, diffraction at a straight edge, diffraction by a narrow obstacle, Babinet's principle

Week 10: Brewster's law, Malus's law, Phenomenon of double refraction, normal and oblique incidence, production of polarized light

Week 11: Quarter and half wave plates, analysis of polarized light, optical activity, plane wave propagation in anisotropic media

Week 12: Antireflection coatings, basics concepts of holography, basics concepts and ray optics considerations of optical fiber, introduction to lasers