PHY-305 Optics & Lasers

Credit Hours: 3-0

Pre-requisites: None

Course Objectives:

It is an undergraduate core course and aims to make students understand about optical instruments, and interaction of light with these instruments. The students shall learn about the phenomenon of reflection and refraction by various optical systems including mirrors and lenses. The application of these phenomenon in optical devices shall be explained through simple examples of The Camera, The Eye, Telescope and the Microscope. The principles of wave propagation and their superposition resulting into constructive and destructive interference. diffraction patterns and polarization of light. Finally, the concept of Laser and its operation shall be described.

Course Contents: Introduction to light, Geometric Optics, Reflection, Refraction, Snell's law, Total internal reflection, Huygen's principle, Dispersion and dispersive elements, Fermat's principle, Image formation by plane mirrors, spherical mirrors, lenses, aberrations, The camera, The eye, microscope, telescope, Interference, Young's double slit experiment, phasor addition, phase shift, interference in thin films, Michelson interferometer, Fabry Perot Interferometer, Diffraction pattern, Diffraction from narrow slits, aperture and resolution, Diffraction grating and polarization of light, Fourier Optics and Fresnel Equation.

Recommended Books:

Main Textbook: Physics for Scientists and Engineers, 6th Edition
Author: R. A. Serway and J. W. Jewett
Publisher: Thomson Brooks/Cole © 2004
Referred as: SJ

Textbooks: Introduction tp Optics, Third Edition
Author: F. L. Pedrotti, L. M. Pedrotti, and L. S. Pedrotti
Publisher: Pearson Education India, 2008
Referred as: PPP

Weekly Breakdown		
Week	Section	Topics
1	SJ Ch. 35, pp. 1095-1101	The nature of light, Speed of light, Reflection.
2	SJ Ch. 35, pp. 1102-1109	Refraction, Index of refraction, Snell's law, Huygen's Principle.
3	SJ Ch. 35, pp. 1109-1115	Dispersion, Prisms, Optical fibers, Hermat's principle.
4	SJ Ch. 36, pp. 1127-1137	Image formation by plane mirror and spherical mirrors.
5	SJ Ch. 36, pp. 1138-1152	Image formation by refraction (Lenses).
6	SJ Ch. 36, pp. 1153-1160	Aberration, Examples of optical instruments (The Eye, The Camera, The telescope, The microscope).
7	SJ Ch. 37, pp. 1177-1184	Conditions of Interference, Young's Double-slit Experiment, Intensity distribution of Interference pattern.
8	SJ Ch. 37, pp. 1184-1193	Phasor diagram for waves, Phase change due to reflection, Interference in thin films.
		Mid Term Exam
9	SJ Ch. 37, pp. 1194-1195	Michelson Interferometer, Fourier Transform Infrared spectroscopy, Fabry Perot Interferometer, Laser Interferometer Gravitation-Wave Observatory
10	SJ Ch. 38, pp 1207-1214	Diffraction and diffraction patterns, Diffraction patterns from narrow slits, Intensity of single- and double-slit diffraction patterns
11	SJ Ch. 38, pp 1214-1223	Resolution of single-slit and circular apertures, The diffraction grating, Resolution of the Diffraction grating
12	SJ Ch. 38, pp 1224-1232	Diffraction of X-rays by crystals, Polarization of light, Polarization by selective absorption, polarization by reflection, Polarization by double refraction, Optical cavity
13	PPP Ch. 6.1, 6.2, 131-138	Introduction to Laser, Energy quantization in Light and Matter, Thermal equilibrium and Black Body Radiation
14	PPP Ch. 6.4-6.7 139-503	Einstein's theory of light – matter interaction, stimulated Absorption and Emission, Spontaneous Emission, Elements of a Laser, Characteristics of a Laser
15	PPP Ch. 6.7, 26.1-26.3, 549-560	Description of Laser Operation, Rate equation, Absorption, Gain Media
16	PPP Ch. 26.4-26.8, 561-575	Steady state laser output, Homogeneous and Inhomo dependent phenomenon