FIRST SEMESTER 2018-2019

Course Handout (Part II)

Date: 02/08/2018

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No.: PHY F213

Course Title:OPTICS

Instructor-in-charge: MANJULADEVI. V

Course Description:

The course will cover Geometrical optics, Crystal optics, Diffraction, Laser theory and the recent trends of research in the optical physics.

Scope and objective of the course:

The objective of the course is to give an introduction to basic phenomena in optics and the techniques used to deal with them. The recent development of the subject and its application in the research level will be discussed. Course will assume a basic knowledge of optics at the level of the core Physics courses. The course will also provide theoretical background for the optics experiments done in Electromagnetism & Optics Lab. (PHYF214).

Text Book (TB):

Optics: AjoyGhatak, 5th Edition, Tata McGraw Hill (2012)

Reference Book (RB):

1. Principles of Optics, B. K. Mathur
2. Introduction to Electrodynamics, David J. Griffiths, 3rd Ed., Pearson, 1999
3. Lasers and non-linear optics, B. B. Laud, 2nd Ed., Wiley Eastern Ltd
4. Optical Physics by A. Lipson, S. G. Lipson, H. Lipson, Cambridge university press, 2010

1. Course Plan:

Lecture No.	Learning Objectives	Topics to be covered	Reference Chap. Sec. #	Learning outcome
1-4	Introduction to optics, Fermat's principle and applications	Basic introduction to optics, Newton's corpuscular model, laws of reflection and refraction from Fermat’s principle, ray equations, ray paths	2&3,28.1 to 28.7	Understand the basic optical phenomenon. why Newton's corpuscular model was a failure? Correct explanation of reflection refraction using Fermat's principle, predict the angles of refraction and reflection at interfaces, understanding various optical phenomena for ex: mirage by solving the ray equation, obtain ray paths in inhomogeneous media for ex: optical fiber, transit time calculation in an optical fiber, Numerical aperture
5-8	Matrix methods in paraxial optics	Matrices for translation, refraction and reflection, unit planes, nodal points, system of two thin lenses	5.1-5.5	In Paraxial approximation, applying the matrix method to a given set of many lenses, student will be able to predict by calculation the exact location of image, magnification factor; and

				focal length of any optical system with many optical components without performing actual experiments,
9-11	Aberrations	Chromatic and Spherical Aberration, achromatic doublet, separated doublet	6.1-6.3.1	Understand that Chromatic aberration is a distortion of image occurring due to the variation of refractive index of the material of lens with wavelength of light, Designing achromatic doublet Will be able to propose a design for an optical system with minimal optical distortions
12-15	Origin of refractive index, dispersion and scattering theory	Origin of refractive index, refractive index is complex, Rayleigh Scattering, Dispersion	7.5, 7.6 Lecture notes	Knowledge about Origin of index of refraction of a medium and effect of damping coefficient of a given medium on refractive index. explanation for why a given medium looks of a particular colour for example the most fundamental example: Why sky looks blue? Dispersion: variation of refractive index

				with frequency
16-17	Coherence	Line width of a source, spatial coherence, coherence time	17.1-17.3, 17.6	Student will be able to define and hence estimate coherence time and coherence length of a given source, estimate the monochromaticity or the spectral purity of source , concept of aptialchoerence
18-22	Diffraction	Fresnel and Fraunhofer diffraction: Single slit diffraction, double slit diffraction, N slit diffraction, Fresnel half period zones, diffraction by circular aperture, Zone plate	18.1,18.2,18.6-18.7,RB1, Lecture notes	Will learn difference between Fresnel and Fraunhofer diffraction, theory of Frensel zones, construction of zone plate and its applications; will be able to calculate the Fresnel diffraction patterns of slits of various shapes; Relation between Fraunhofer diffraction and Fourier transform; Fraunhofer diffraction by single slit and double slit, a student will be able to apply the concept of N slit diffraction to understand the working principle of

				grating and dispersion power of grating, its application in optics as well as solid state physics
23-27	Basic of wave motion, group velocity and Dispersion	1D wave equation and its general solution, Wave Equation, Poynting vector, oscillating dipole,dispersion and group velocity, normal and anomalous dispersion	11.9, 10.1-10.3, RB 2	Concept of group velocity and phase velocity, variation of refractive index with wavelength; calculation of material dispersion coefficient, Poynting vector; Energy travels with group velocity; negative refractive index
28-31	Polarization	Malus' law, double refraction Optical activity, linearly polarized light, Circular polarized light,	22.1-22.17	Polarization of EM wave; student can design a filter with varying gray scale intensity; how to control polarization of EM waves at interfaces with various angles of incidence, concept of Brewster angle and importance of Brewster angle in various applications, Jones matrix representation, ray velocity and ray refractive index, Faraday rotation
32-35	Maxwell's	wave propagation in	20.3-20.5,	Application of Maxwell's

	equations and Electromagnetic waves,	anisotropic media, Plane wave propagation in anisotropic media, Reflection and Refraction of EM waves, Reflection and transmission coefficients,	19.12, 21.1-21.2 & RB 2	equations to EM waves, Estimation of Reflection and transmission coefficients of parallel and perpendicular polarized components of EM waves in isotropic medium, How an EM wave propagates through anisotropic medium, why the direction of propagation of wave is not the direction of energy propagation direction in anisotropic medium?; Propagation of EM waves in uniaxial crystals
36-40	Lasers and applications of lasers	Spontaneous emission, Stimulated emission, Einstein coefficients, threshold condition, somelaser systems, application of lasers: Non Linear Optical effect ; Second Harmonic Generation	RB 3, Lecture notes	How stimulated emission is responsible for lasing action? why the spontaneous emission is useless for lasing; concept of spatial and temporal coherence and their importance; classical and quantum mechanical treatment of photons to understand the basics of lasers; applications of lasers

				leading to modern optics applications, Kerr effect, Pockel effect, Nonlinear optical effect, concept of second harmonic generation and its importance

Evaluation Scheme:

EC No.	Component	Duration	Weightage (%)	Date & Time	Nature
1	Mid-Sem Test	90 minutes	30	9/10 9:00 - 10:30 AM	Closed Book
2	Tutorial Tests/Assignments		30		Closed/Open Book
4	Comprehensive Examination	3 hours	40	3/12 FN	Closed Book/Open Book

Chamber Consultation Hour: To be announced in the class

Notices: All notices will be displayed on Physics Department Notice Board

Make-up Policy: Make-up will be given only in genuine cases.

Instructor-in-charge

PHY F213