

GENERIC ELECTIVES (GE – 3): WAVES AND OPTICS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/Practice		
Waves and Optics GE 3	4	3	0	1	Class XII pass	NIL

Learning Objectives

This coursework reviews the concept of waves and optics learnt at school level from a more advanced perspective and builds new concepts. This course is divided into two main parts. The first part deals with vibrations and waves. The second part pertains to optics and provides the details of interference, diffraction and polarization.

Learning Outcomes

After the completion of this course, the students will have learnt the following.

- Simple harmonic motion, superposition principle and its application to find the resultant of superposition of harmonic oscillations.
- Concepts of vibrations in strings.
- Interference as superposition of waves from coherent sources.
- Basic concepts of Diffraction: Fraunhoffer and Fresnel Diffraction.
- Elementary concepts of the polarization of light.

SYLLABUS OF GE – 3

THEORY COMPONENT

Unit 1: **(10 Hours)**

Superposition of Harmonic Oscillations: Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear harmonic oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of two perpendicular harmonic oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses.

Unit 2: **(5 Hours)**

Waves M otion: Types of waves: Longitudinal and Transverse (General idea). Travelling waves in a string, wave equation. Energy density. Standing waves in a string - modes of vibration. Phase velocity.

Unit 3: (12 Hours)

Interference of Light: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Interference: Division of amplitude and division of wave front. Young's Double Slit experiment. Fresnel's Biprism. Phase change on reflection: Stoke's treatment. Interference in Thin Films: parallel and wedge-shaped films. Newton's Rings: measurement of wavelength and refractive index.

Unit 4: (12 Hours)

Diffraction: Fraunhofer diffraction - Single slit, Double slit and Diffraction grating. Fresnel Diffraction - Half-period zones, Zone plate, Fresnel Diffraction pattern of a straight edge using half-period zone analysis.

Unit 5: (6 Hours)

Polarization: Transverse nature of light waves. Plane polarized light. Production and detection of linearly polarized light. Malus's Law. Idea of circular and elliptical polarization.

PRACTICAL COMPONENT (30 Hours)

Every student must perform at least 05 experiments out of the list following experiments.

- 1) To determine the frequency of an electrically maintained tuning fork by Melde's experiment and to verify $\lambda^2 - T$ Law.
- 2) To study Lissajous Figures.
- 3) Familiarization with Schuster's focusing and determination of the angle of prism.
- 4) To determine the refractive index of the material of a prism using sodium light.
- 5) To determine the dispersive power of a prism using mercury light.
- 6) To determine wavelength of sodium light using Newton's rings.
- 7) To determine wavelength of sodium light using a plane diffraction grating.
- 8) To verify Malus's Law.
- 9) To determine the wavelength of Laser light using single slit diffraction. (Due care should be taken not to see Laser light source directly as it may cause injury to eyes.)

References (for Laboratory Work):

- 1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, Asia Publishing House
- 2) A Text Book of Practical Physics, Indu Prakash and Ramakrishna, Kitab Mahal
- 3) An advanced course in practical physics, D. Chattopadhyay and P. C. Rakshit, New Central Book Agency

Essential readings:

FOR THEORY COMPONENT

- 1) The Physics of Waves and Oscillations: N K Bajaj, Tata McGraw Hill
- 2) Optics: Ajoy Ghatak, Seventh edition, McGraw Hill
- 3) Principle of Optics: B. K. Mathur and T. P. Pandya, Gopal Printing Press
- 4) Optics: Brij Lal and N. Subramanyam, S. Chand
- 5) The Fundamentals of Optics: A. Kumar, H. R. Gulati and D. R. Khanna, R. Chand

Suggestive readings:

- 1) Vibrations and Waves: A. P. French, CRC
- 2) The physics of Vibrations and Waves: H. J. Pain, Wiley
- 3) Fundamentals of Optics: Jenkins and White, McGraw Hill
- 4) Optics: E. Hecht and A R. Ganesan, Pearson, India
- 5) Introduction to Optics: F. Pedrotti, L. M. Pedrotti and L. S. Pedrotti, Pearson, India

GENERIC ELECTIVES (GE - 6): INTRODUCTORY ASTRONOMY**Credit distribution, Eligibility and Pre-requisites of the Course**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/Practice		
Introductory Astronomy GE 6	4	3	1	0	Class XII pass	NIL

Learning Objectives

This course is meant to introduce undergraduate students to the wonders of the Universe. Students will understand how astronomers over millennia have come to understand mysteries of the universe using laws of geometry and physics, and more recently chemistry and biology. They will be introduced to the Indian contribution to astronomy starting from ancient times up to the modern era. They will learn about diverse set of astronomical phenomenon, from the daily and yearly motion of stars and planets in the night sky which they can observe themselves, to the expansion of the universe deduced from the latest observations and cosmological models. Students will also be introduced to internet astronomy and the citizen science research platform in astronomy. The course presupposes school level understanding of mathematics and physics.

Learning Outcomes

- After completing this course, student will gain an understanding of,
- Different types of telescopes, diurnal and yearly motion of astronomical objects, astronomical coordinate systems and their transformations
- Brightness scale for stars, types of stars, their structure and evolution on HR diagram
- Components of solar system and its evolution
- Current research in detection of exoplanets
- Basic structure of different galaxies and rotation of the Milky Way galaxy
- Distribution of chemical compounds in the interstellar medium and astrophysical conditions necessary for the emergence and existence of life
- Internet based astronomy and the collaborative citizen astronomy projects