B. Sc. II Year		BPH-C401			Semester-IV
DSC 4		WAVES AND OPTICS			
Total Lectures	Time Allotted for End Semester Examination	Marks Allotted for Continuous Assessment	Marks Allotted for End Semester Examination (ESE)	Maximum Marks (MM)	Total Credits
60	3 Hrs	30	70	100	04

NOTE: The question paper shall consist of TWO sections (Sec.-A, Sec.-B). Sec.-A shall contain 10 short answer type questions of Five mark each and student shall be required to attempt any Five questions. Sec.-B shall contain 8 descriptive type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllbus. The previous year paper/model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). **(4 Lectures)**

Superpositionof Two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. **(2 Lectures)**

W**aves Motion- General**: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity. **(7 Lectures)**

Oscillations:. Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations**. (6 Lectures)**

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem- Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings (General idea). **(6 Lectures)**

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **(3 Lectures)**

Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. **Interference in Thin Films:** parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). **Newton's Rings**: measurement of wavelength and refractive index. **(10 Lectures)**

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, Visibility of fringes.

(3 Lectures)

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. **(14 Lectures)**

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization. **(5 Lectures)**

Reference Books

- Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
- UniversityPhysics.FWSears,MWZemanskyandHDYoung13/e,1986.Addison- Wesley

(i) Course learning outcome:

This course will enable the student to

- Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems.
- Apply basic knowledge of principles and theories about the behavior of light and the physical environment to conduct experiments.
- Understand the principle of superposition of waves, so thus describe the formation of standing waves.
- Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.
- Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.
- Understand the working of selected optical instruments like biprism, interferometer, diffraction grating, and holograms.
- In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt first hand.
- The motion of coupled oscillators, study of Lissajous figures and behavior of transverse, longitudinal waves can be learnt in this laboratory course.

(ii) Broad contents of the course:

- Superposition of Two Collinear Harmonic Oscillations
- Superposition of Two Perpendicular Harmonic Oscillations
- Waves Motion – General
- Velocity of Waves
- Superposition of Two Harmonics Waves
- Wave Optics
- Interference
- Michelson's Interferometer
- Diffraction
- Fraunhofer Diffraction
- Fresnel Diffraction
- Polarization

(iii) Skills to be learned

- This course in basics of optics will enable the student to understand various optical phenomena, principles, workings and applications optical instruments
- He / she shall develop an understanding of Waves Motion and its properties.