BPHCT-137

ASSIGNMENT BOOKLET

BACHELOR'S DEGREE PROGRAMME
(BSCG/BSCM)

WAVES AND OPTICS

Valid from 1st January, 2025 to 31st December, 2025

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2025)

Dear Student,

Please read the section on assignments in the Programme Guide for B. Sc. that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet, and it consists of two parts, Part A and B. The total marks of all the parts are 100, of which 35% are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.: ……

NAME: ……

ADDRESS: ……

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COURSE CODE:……..

COURSE TITLE: ……

ASSIGNMENT CODE: ……..

STUDY CENTRE: …….. **DATE:** ……..

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
4) Your answers should be precise.
5) Solve Part A and Part B of this assignment, and **submit the complete assignment answer sheets containing Parts A and B within the due date.**
6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. **Answer sheets received after the due date shall not be accepted.**

   We strongly suggest that you retain a copy of your answer sheets.
7) This assignment is **valid from 1st January, 2025 to 31st December, 2025**. If you have failed in this assignment or fail to submit it by 31st December, 2025, then you need to get the assignment for the year 2026, and submit it as per the instructions given in the Programme Guide.
8) **You cannot fill the examination form for this course** until you have submitted this assignment. For any queries, please contact: srjha@ignou.ac.in, drsgupta@ignou.ac.in.

   We wish you good luck.

Tutor Marked Assignment
WAVES AND OPTICS

Course Code: BPHCT-137
Assignment Code: BPHCT-137/TMA/2025
Max. Marks: 100

Note: Attempt all questions. The marks for each question are indicated against it.

PART A

1. a) A sinusoidal wave is described by

$$y(x, t) = 3.0 \sin (3.52t - 2.01x) \text{ cm}$$

where x is the position along the wave propagation. Determine the amplitude, wave number, wavelength, frequency and velocity of the wave. (2×5)

b) A stretched string of mass 20 g vibrates with a frequency of 30 Hz in its fundamental mode and the supports are 40 cm apart. The amplitude of vibrations at the antinode is 4 cm. Calculate the velocity of propagation of the wave on the string. (5)

c) Show that superposition of two linearly polarised light waves having different amplitudes and a finite phase difference can be used to produce elliptically plane polarised waves. Also show that the linear polarisation and circular polarisation are special cases of elliptical polarisation. (5+5)

2. a) What is a biprism? The inclined faces of a glass biprism (μ = 1.5) make an angle of 1° with its base. The biprism is illuminated by sodium lamp (λ = 589 nm) and the eye piece is at a distance of 1 m from the slit. A convex lens inserted between the biprism and the eye piece gives clear images of coherent sources in the focal plane of the eye piece. If the images are 0.4 cm apart in one case and 0.16 cm apart in the second case, calculate the width of interference fringes observed on the screen. (2+8)

b) i) Show that the radius of a dark Newton's ring is directly proportional to the square root of the radius of curvature of the lens used. (5)

ii) Newton's rings are formed in reflected light of wavelength 5890×10^{-8} cm with a liquid between the plane and curved surfaces. The diameter of the fifth ring is 0.3 cm and the radius of curvature of the curved surface is 100 cm. Calculate the refractive index of the liquid, when the ring is bright. (5)

c) Explain how Michelson interferometer is used to determine the wavelength of light. (5)

PART B

3. a) A vertical single and double slits and illuminated by a point source. Discuss the salient features of their Fraunhofer diffraction patterns. Also, obtain an expression for intensity distribution in case of double slit. (5+5+10)

b) 'Diffraction limits the image forming capability of optical devices'. Discuss the authenticity of this statement for the particular case of a microscope. (5)

4. a) Discuss applications of lasers in medicine and communication. (5)

   b) Define numerical aperture and angle of acceptance. An optical fiber has a numerical aperture of 0.20 and cladding refractive index of 1.59. Calculate the refractive index of the core material and the acceptance angle of the fibre in water whose refractive index is 1.33. (5+5)

   c) With the help of a labeled diagram, discuss lasing action of a He-Ne laser. (5)

   d) The refractive index of the core and cladding materials of an optical fibre is 1.52 and 1.46, respectively. Calculate the critical angle, numerical aperture and acceptance angle at the air-fibre interface. (5)

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