

বিদ্যাসাগর বিশ্ববিদ্যালয়

VIDYASAGAR UNIVERSITY

Question Paper

B.Sc. Honours Examination 2023

(Under CBCS Pattern)

Semester — II

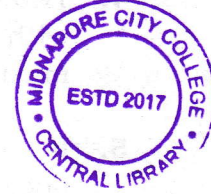
Subject : PHYSICS

Paper : C-4T

(Waves and Optics)

Full Marks : 40

Time : 2 hours



*Candidates are required to give their answers
in their own words as far as practicable.*

The figures in the margin indicate full marks.

Answer from **all** the Groups as directed.

GROUP—A

Answer *any five* questions from the following :

2×5=10

1. What are beats? Show that the beat frequency is equal to the difference of frequencies of the component oscillations.

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(Turn Over)



- (2)
2. The diameter of the n^{th} Newton's ring changes from 1.2 cm to 1.0 cm, when the air space between the lens and the plate is replaced by a transparent liquid. Find the refractive index of the liquid.

3. If the source of light used in Young's double slit experiment is changed from red to violet, what will be the change in fringe width?
4. Two laser sources of equal amplitudes interfere with each other. Calculate the values of the maximum and the minimum intensities.
5. If the atmospheric temperature increases, how does it affect the speed of sound according to Newton's formula? Provide a brief explanation.
6. A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 cm away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen. Find the width of the slit.
7. If the length of a stretched string is doubled while maintaining the same tension and mass per unit length, how does this affect the fundamental frequency of the standing wave that can be produced on the string?

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(Continued)

(3)

8. Define the visibility of fringes in a Fabry-Perot interferometer. How does it depend on the transparency of the film?

GROUP—B



Answer *any four* questions from the following :

5×4=20

9. Explain the basic principle of holography. How does holography differ from conventional photography in terms of capturing and reproducing three-dimensional images? Provide a brief overview of the process. 2+3=5

10. (a) Discuss how the Fraunhofer diffraction pattern changes when a double slit is used instead of a single slit.

(b) A laser beam with a wavelength of 632.8 nm is directed at a single slit. If the width of the slit is 0.05 mm and the screen is placed 1 m away, calculate the width of the central diffraction maximum.

3+2=5

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(Turn Over)



(4)

Two simple harmonic motions act simultaneously on a particle at right angles to each other. Show that the path of the particle will be an oblique ellipse when two motions have the same period but different amplitudes and initial phase difference. What happens when the phase difference between the motions is zero and π ? $3+2=5$

12. (a) Explain the two classes of interference with suitable examples — division of wavefront and division of amplitude.

(b) State the conditions for producing distinct interference patterns. $3+2=5$

13. (a) Consider an open pipe and a closed pipe, both with the same length. Which one would produce a higher fundamental frequency and why? Discuss how the boundary conditions at the open end and the closed end contribute to the frequencies produced by each type of pipe. $2+2=4$

(b) What do you understand by the 'normal modes' of vibration? 1

14. What is zone plate? How is it constructed? Explain its action as a convex lens. Point out the differences between convex lens and zone plate. $1+1+2+1=5$

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(5)
GROUP—C



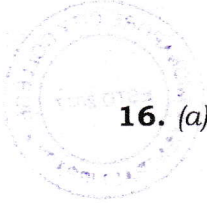
Answer any one question from the following : $10 \times 1 = 10$

15. (a) A uniform string of length l is stretched between its fixed ends $x = 0$ and $x = l$. Obtain an expression for the transverse displacement $y(x, t)$ of the string when it is struck at the centre so that the velocity varies linearly from zero at the ends to v_0 at the centre. 4

(b) A string has a linear mass density 0.25 kg/m and stretched along the x -axis with a tension 25 N . One end of the string ($x = 0$) is given a sinusoidal motion with a frequency 5 Hz and amplitude 0.1 m . At time $t = 0$, the end has zero displacement and it is moving in positive y -direction. Find the wave speed and the amplitude in the string. Also write a wave equation. Find the displacement of the string at $x = 0.25 \text{ m}$ and $t = 0.1 \text{ s}$. Find the slope of the string at the same values of x and t . 4

(c) Write down the equations of spherical and cylindrical waves. 2

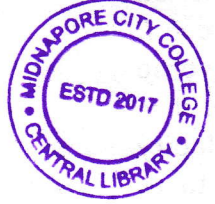
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(6)

16. (a) Obtain the intensity expression for Fraunhofer diffraction pattern of a plane diffraction grating. Deduce the condition for the secondary maxima and minima. What is missing order? $4+3+1=8$

(b) What is the difference between a grating spectra and prism spectra? 2



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