

B.Sc. 2nd Semester (Honours) Examination, 2021-22

PHYSICS

Course ID: 22412

Course Code: SH/PHS/202/C-4/T-4

Course Title: Waves and Optics (T4)

Time: 1 Hour and 15 Minutes

Full Marks: 25

*The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable*

Section-I

1. Answer *any five* of the following questions: **1×5=5**
- (a) A particle is subjected to two mutually perpendicular SHM such that $x = 2 \sin(\omega t)$ and $y = 2 \sin(\omega t + \frac{\pi}{2})$. What is the nature of the path of the particle?
 - (b) Make a brief comparative study between Fresnel and Fraunhofer diffraction.
 - (c) What is a forced oscillator?
 - (d) Mention one use of beat.
 - (e) What do you mean by spatial coherence?
 - (f) Give two examples of optical devices which can produce interference fringes using the method of division of wave front of incident beam.
 - (g) “All simple harmonic motions are periodic, but all periodic motions are not simple harmonic” – Explain.
 - (h) What do you mean by resolving power of a grating?

Section-II

2. Answer *any two* of the following questions: **5×2=10**
- (a) Show that when beams of plane monochromatic light from an extended source fall on a thin film, the transmitted beams will produce interference fringes. Obtain the

condition for constructive interference in this case. Explain why the central fringe in Lloyd's mirror is dark? 2+2+1

(b) What is the difference between grating spectrum and prism spectrum? How many lines per cm are there in a grating which produces a deviation of 30° in the 2nd order of light of wavelength 6×10^{-5} cm? 2+3

(c) Explain the following statement "*interference is a phenomenon of the wave nature of light*". Write down the resultant intensity equation when two light rays from coherent sources superpose with each other, having a phase difference δ and discuss the case with $\cos\delta = +1$ and $\cos\delta = -1$. 3+2

(d) Establish the relation between wave velocity and particle velocity for a progressive wave in a medium. Prove that in simple harmonic motion, the average potential energy equals to the average kinetic energy when average is taken with respect to time over one period of motion. 3+2

Section-III

3. Answer any *one* of the following questions: 10×1=10

(a) (i) What do you mean by fringes of equal width and fringes of equal inclination?

(ii) In a Fresnel's biprism experiment, the fringes are produced with monochromatic light of wavelength 689 nm. A thin film of glass of refractive index 1.52 is placed normally in the path of one of the interfering rays. The central bright fringe is found to move to a position occupied by fifth bright band from the centre. Calculate the thickness of the film.

(iii) In Michelson's interferometer, 100 fringes cross the field of view when the movable mirror is displaced through 0.02948 mm. Calculate the wavelength of the monochromatic light used. 4+3+3

(b) Establish the differential equation of damped oscillation. Solve the equation and discuss over damping, critical damping and under damping condition. What is logarithmic decrement? 2+(2+2+2)+2