U.G. 2nd Semester Examination - 2021

PHYSICS

[HONOURS]

Course Code: BPHSCCHC 202

Course Title: Waves and Optics

Full Marks : 30 Time : 2 Hours

The figures in the right-hand margin indicate marks.

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

1. Answer any **ten** questions from the following: $1\times10=10$

a) What is the significance of linearity used in the principle of superposition?

b) What is the role of the compensator in Michelson interferometer?

c) Write the expression for the intensity distribution of light in single slit diffraction and draw it.

d) Define plane transmission grating with a grating equation.

e) What do you mean by temporal coherence?

f) How will you increase the resolving power of a diffraction grating?

g) Two Simple Harmonic Motions of the same amplitude, period and phase act at right angles to each other. The resultant vibration will be (i) elliptical (ii) circular (iii) straight line (iv) none of the above.

h) How the energy falls off with distance r for a spherical wave?

i) What do you mean by fringes of equal thickness (Fizeau fringes)?

j) Why broad source is necessary for Newton's rings experiment?

k) What happens when white light is used to illuminate the slit in biprism experiment?

l) The variation of frequencies (ν_n) with mode number (n) for normal modes varies as

(i) $\nu_n \alpha\, n^2$ (ii) $\nu_n \alpha\, n^3$

(iii) $\nu_n \alpha\, 1/n$ (iv) $\nu_n \alpha\, n$

m) What do you mean by plucked string and struck string?

n) Distinguish between Fraunhofer and Fresnel diffractions.

o) What is the radius of the first zone in a plate of principal focal length 20 cm for light of wavelength 6000Å?

2. Answer any **five** questions: 2×5=10

a) An increase of pressure of 100 kPa causes a certain volume of water to decrease by 5×10^{-3} percent of its original volume. Show that the speed of sound in water is about 1414 m/sec.

b) A mica sheet of refractive index 1.58 is introduced in one of the interfering beams and the central fringe gets shifted by 0.2 cm. The distance between the coherent sources is 0.1 cm and the screen is placed at a distance of 50cm from the sources. Determine the thickness of the mica sheet.

c) Show that the intensity of a plane wave in a gas is equal to the energy density times the wave velocity.

d) Explain what happens to the ring pattern of Newton's ring experiment when the lens is slowly raised vertically above the plate.

e) A 10m long wire is stretched between two fixed supports such that two adjacent

harmonic frequencies are 255 Hz and 306 Hz. Find out the fundamental frequency of the wire.

f) Show that the function $\psi(x,t) = f(x + vt)$ is a solution of the differential wave equation. What will be the direction of the wave propagation?

g) How can we use Fabry-Perot interferometer to determine the frequency difference of two close spectral lines?

h) A parallel glass plate of index 1.5, 2.5mm thick, generates a concentric ring system of fringes under normal illumination at a vacuum wavelength of 750nm. Determine the order of the central fringe. Is it a maximum, minimum or neither?

3. Answer any **two** questions: 5×2=10

a) What are the conditions to get sustained interference pattern? Distinguish between interference and diffraction. In a Newton's rings experiment the diameter of the 12th ring changes from 1.50 cm to 1.35 cm, when a liquid is introduced between the lens and the

glass plate. Calculate the refractive index of the liquid. $1\frac{1}{2}+1\frac{1}{2}+2$

b) State and explain the Rayleigh's criterion of resolution. Write the differences between holography and photography. Find the missing orders for a double slit Fraunhofer pattern if the width of each slit is 0.15 mm and they are separated by a distance of 0.60 mm.

$1\frac{1}{2}+1\frac{1}{2}+2$

c) Derive an expression for the intensity of the fringe system formed by the transmitted light in a Fabry-Perot Interferometer. Why are the outer surfaces of the plates of a Fabry-Perot Interferometer kept slant? 4+1

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