U.G. 2nd Semester Examination - 2020

PHYSICS

[HONOURS]

Course Code : PHSH/CC-T-04

Full Marks : 40 Time : $2\frac{1}{2}$ 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.

GROUP–A

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

   a) Write down the difference between progressive and stationary waves.

   b) What is ideal string?

   c) What is meant by Rayleigh Criterion of resolution?

   d) Explain the rectilinear propagation of light on the basis of wave theory.

   e) What are the factors on which the amplitude of light waves from a half-period zone at the point of observation depend?

   f) Sound emitted from struck string will be richer in harmonics than that of plucked string. Explain.

   g) State the conditions to be fulfilled for the production of sustained interference fringes.

   h) Why is the base angle of biprism of Fresnel biprism experiment made very small?

GROUP–B

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

   a) i) Show that the beat frequency is equal to the difference in frequencies of the component oscillations.

   ii) Neglecting the effect of surface and finite depth, the wave velocity of water waves of wavelength (λ) is given by

$$C_p = \sqrt{\frac{g\lambda}{2\pi}}$$

   Prove that the group velocity is half the wave velocity. 3+2

b) i) Calculate the resultant displacement of the superposition of N number of simple harmonic motions having equal amplitudes, equal frequencies and equal successive phase differences.

ii) Show that the energy density in a stationary wave is twice that of a progressive wave. 2+3

c) i) Obtain the intensity expression for Fraunhofer pattern of a double slit.

ii) Distinguish between the resolving power and dispersive power of a grating. 3+2

d) i) Under what conditons circular and straight fringes are produced by Michelson's interferometer.

ii) Explain the colour phenomenon exhibited by thin flims. 2+3

GROUP-C

3. Answer any **two** questions: 10×2=20

a) i) Show that the velocity of transverse waves along a stretched string is given by

$$c = \sqrt{\frac{T}{m}}$$

where T is the tension and m is the mass per unit length of the string.

ii) What are Lissajous figures? How can it be demonstrated experimentally? Explain how the pattern changes with time when frequencies of the component oscillations differ slightly. 4+(1+2+3)

b) i) Describe how the wavelength of a monochromatic light can be measured by Fresnel's biprism. Draw the ray diagram.

ii) Why it is necessary to use narrow source for Fresnel's biprism and extended source for Newton's ring experiment?

iii) A monochromatic beam of light on passing through a slit 1.6mm wide falls on a screen held close to the slit. The screen is gradually moved away and the middle of the patch of light on it becomes dark when the screen is 50cm from the slit. Calculate the wavelength of light. (3+1)+3+3

c) i) Show that the group velocity c_g and phase velocity C are related as

$$c_g = c - \lambda \frac{dc}{d\lambda}$$

where λ is the mean wavelength.

ii) For a stretched string of length *l* the displacement is given by

$$y(x,t) = \sum_{n=1}^{\infty} c_n \sin\frac{n\pi x}{l} \cos(\omega_n t - \phi_n)$$

where the symbols have their usual significance. Show that the total energy of the string is

$$E = \frac{M}{4} \sum_n \omega_n^2 c_n^2$$

where M is the mass of the string.

2+(4+4)

d) i) Show that in Young's experiment that in two dimensions the shape of the fringes is hyperbolic. Why these fringes are called non-localized?

ii) A zone plate is constructed so that the radii of the circular zones as the same as the radii of dark Newton's ring formed between a plane surface and plano-convex lens having radius of curvature 2m. Find the principal focal length of the zone plate.

iii) Fraunhofer diffraction pattern is observed by a double slit having slit width a=0.16mm and separation between the slits b=0.8mm. Find the missing orders.

(3+1)+3+3

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