WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 2nd Semester Examination, 2022

PHSACOR04T-PHYSICS (CC4)

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Question No. 1 is compulsory and answer any *two* from the rest

1. Answer any ***ten*** questions from the following: 2×10 = 20

   (a) What are the combination tones?

   (b) State the 'principle of superposition' of waves.

   (c) What do you mean by 'temporal' and 'spatial' coherence?

   (d) Is it possible to have interference without diffraction? — Explain.

   (e) What are the differences between 'in-line-holography' and 'off-axis-holography'?

   (f) State Rayleigh's criteria on resolution.

   (g) A plane transmission grating having 6000 lines is used to obtain a spectrum of light from a sodium lamp in second order. Calculate the angular separation between two sodium lines with wavelengths are 5890 Å and 5896 Å respectively.

   (h) In a Newton's ring experiment, the diameters of the n^{th} ring (bright) with air film and liquid film are 2.4 mm and 2.0 mm respectively. Calculate the refractive index of the liquid.

   (i) Explain, why extended light source is required to observe the interference with thin film.

   (j) What is the difference between the fringes produced by Michelson's interferometer and Newton's ring?

   (k) Define 'bel' and 'phon'.

   (l) State and differences between grating spectra and prism spectra.

   (m) A two slit interference pattern is observed in air (refractive index 1). Then the entire system is immersed in water (refractive index 1.33). Mention the changes observed in the fringe system.

   (n) Show that $f(ct-x)$ is a solution of the one dimensional wave equation where the symbols have their usual meanings.

2. (a) What are beats? Explain graphically and mathematically their production. Also, derive an expression for the frequency of beats. 2+(2+2)+2

(b) Two tuning forks A and B, the frequency of B being 512, produce 5 beats per sec. A is filed and the beats are found to occur at shorter intervals. Find the frequency of A. 2

3. (a) Briefly describe the formation of stationary waves for the transverse vibration of string under tension and fixed at two ends. 3

(b) A whistle emits a note of frequency 1000 Hz, when hydrogen gas (molecular weight 2) is passed through it. When an unknown diatomic gas is passed, the note gets down to 225 Hz. What is the molecular weight of the unknown gas? 3

(c) What is your idea of a wave group? Derive the relation $c_g = c - \lambda \frac{dc}{d\lambda}$, where the symbols have their usual meaning. 1+3

4. (a) Apply Huygen's Principle of wave propagation to prove laws of refraction for a plane surface. 3

(b) Show that in Young's double slit experiment, if we place a thin transparent slab in the path of one of the interfering rays then the entire fringe pattern is shifted (upward) on the screen. 3

(c) Newton's rings are formed with a source of light containing two wavelengths λ_1 and λ_2. If m^{th} order dark ring due to λ_1 coincides with $(m+1)^{th}$ order dark ring due to wavelength λ_2, then prove that the radius of the m^{th} dark ring of λ_1 is equal to $\sqrt{\frac{\lambda_1 \lambda_2 R}{(\lambda_1 - \lambda_2)}}$, where R is the radius of curvature of the plano convex lens. 4

5. (a) Introducing the concept of half period zone in diffraction of light prove that the amplitude due to a large wave front at a point in front of it is just half that due to the first half period zone. Hence, give Fresnel's explanation of the rectilinear propagation of light. 3+1

(b) Derive an expression for intensity at a point in Fraunhofer type of distribution produced by two nearby parallel narrow slits illuminated by monochromatic light. Draw a diagram to indicate the distribution of intensity. 3+1

(c) What is the highest order of spectrum, which may be observed with monochromatic light of $\lambda = 500$ Å by means of a grating with 5000 lines/cm? 2

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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