Fourth Semester B.Sc. Degree Examination, September 2020

(Revised CBCS)

Physics

Paper IV (401) — WAVES, OPTICS AND STATISTICAL PHYSICS

Time : 3 Hours]   *[Max. Marks : 90*

Answers should be written completely in English.

SECTION – A

Answer **any five** of the following questions. Each question carries **8** marks.

$$(5 \times 8 = 40)$$

1. (a) State and explain principle of super position of oscillations.

   (b) Show that the number of beats produced per second is equal to the difference in the frequencies of the two sounding bodies.   (2 + 6)

2. (a) Obtain an expression for equation of a progressive wave in a string.

   (b) Derive an expression for Normal modes of vibration of a stretched string clamped at both ends.   (3 + 5)

3. (a) What are forced vibrations of a body?

   (b) Obtain the general solution of equation of motion of a body and amplitude of the system.   (2 + 6)

4. (a) Define surface tension and surface energy.

   (b) Derive an expression for excess pressure inside a curved liquid surface and arrive at any two special cases.   (2 + 6)

5. (a) What are half period zones?

   (b) Give the theory of diffraction at a straight edge.   (1 + 7)

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6. (a) Obtain an expression for the thickness of quarter wave plate and half wave plate.

   (b) Explain how linearly, circularly and elliptically polarized light are produced and detected?   (3 + 5)

7. (a) Define the terms, phase space, macro state and micro state.

   (b) Obtain Fermi Dirac distribution law.   (3 + 5)

8. Derive an expression for Planck's law by using Bose Einstein's distribution law and hence obtain Wien's law and Rayleigh Jean's law.   (8)

SECTION – B

Answer **any SIX** of the following questions. Each question carries **5** marks.
                                                                              (6 × 5 = 30)

9. Two turning forks of approximately equal frequencies produce Lissajour figures that go through a cycle of changes in 5 seconds. When one fork is loaded with wax the cycle of changes of Lissajous figures takes 10 seconds. If the second tuning fork has a frequency of 400 Hz. Find the frequency of the first fork before and after loading.

10. When a tension of 1 kg wt is applied to a wire 0.9 m long and of density 9000 kg m^{-3} it vibrates with a fundamental frequency of 200 Hz. Calculate the velocity of transverse waves and the longitudinal stress in the string or wire.

11. A source radiates energy at the rate of 3 W. Calculate the acoustic intensity level at a distance of 15 m from the source.

12. Water flows through a horizontal tube of length of 0.2 meters and internal radius 8.1×10^{-4} meter under a constant head of the liquid 0.2 meters high. In 12 minutes 8.64×10^{-4} m^3 of liquid issues from the tube. Calculate the coefficient of viscosity of water (Given the density of water = 1000 kg m^{-3} and g = 9.8 ms^{-2}).

13. A plane transmission grating having 6000 lines per cm is used to obtain a spectrum of light by normal incidence from sodium light in the second order. Calculate the angular separation between the two sodium lines hose wavelengths are 589 mm and 589.6 mm.

14. Plane polarized light is passed through a quartz plate with its axis parallel to the faces. Calculate the least thickness of the plate for which the emergent beam

    (a) Will be plane polarized and (b) Will be circularly polarized.

    Given n_e = 1.553, n_0 = 1.544 and = 600 nm

15. The density of silver is 10.5 g/cm³. Its atomic weight is 108. If each atom contributes one electron for conduction. Calculate (i) the number density of conduction electrons (i) Fermi energy (iii) Fermi temperature (iv) Fermi velocity at Fermi surface.

16. Three particles are to be distributed in four energy levels a, b, c and d. Calculate all possible ways of this distribution when particles are (i) Fermions (ii) Bosons (iii) Classical particles.

SECTION – C

Answer **any TEN** of the following questions. Each question carries **2** marks.

(10 × 2 = 20)

17. (a) What are Lissajous figures. Explain

   (b) When do you get a straight line path as a resultant of motion for a particle subjected to a two harmonic motions.

   (c) Why does an empty vessel produce more sound than a filled one?

   (d) Rain drops assume spherical in shape. Explain.

   (e) Does viscosity of liquid change with temperature? Explain.

   (f) Diffraction effect is common in sound but not in light waves. Explain.

   (g) Does the value of polarizing angle depend on colour of light?

   (h) What are laevo rotator and dextro rotator substances.

   (i) How do the insects run on the surface of water.

   (j) Bosons and fermions have different distribution function. Explain.

   (k) A⁺ 0° all states below Fermi level are occupied while levels above are empty? Explain.

   (l) The amplitude of a simple harmonic oscillator is doubled. How does this affect the time period, total energy and maximum velocity of the oscillator.