

**Fourth Semester B.Sc. Degree Examination, September 2020**

(CBCS Scheme – 2016-18 Repeaters)

**Physics**

**Paper IV – WAVES OPTICS AND STATISTICAL PHYSICS**

Time : 3 Hours]

[Max. Marks : 90

Instructions to Candidates : Answers should be written completely in English.

**PART – A**

- I. Answer any **FIVE** of the following. Each question carries **8** marks : **(5 × 8 = 40)**
1. (a) State and explain principle of superposition of oscillations.  
(b) Show that the superposition principle is valid only in the case of homogeneous linear vibrations. **(2 + 6)**
  2. Derive an expression for velocity of a transverse wave along a stretched string. **(8)**
  3. (a) Define intensity and loudness of sound.  
(b) Obtain an expression for Sabine's formula. **(2 + 6)**
  4. (a) What are synclastic and anticlastic surfaces?  
(b) Define excess pressure and derive an expression for excess pressure inside a soap bubble. **(2 + 6)**
  5. (a) What is a zone plate?  
(b) Give the theory of zone plate. **(1 + 7)**
  6. Explain the production and detection of plane polarized, circularly polarized and elliptically polarized light. **(8)**
  7. Derive an expression for Bose-Einstein distribution law. **(8)**
  8. (a) Define Fermi energy and Fermi sphere.  
(b) Bring out the comparison between Maxwell-Boltzmann Statistics, Bose-Einstein Statistics and Fermi-Dirac Statistics. **(2 + 6)**



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

9. Two tuning forks A and B are of nearly equal frequencies. The frequency of 'B' is 512 Hz. When the two tuning forks are used to obtain Lissajous figures, the complete cycle of changes takes place in 5 seconds when the tuning fork 'A' is filed, the time taken for one cycle of change is 2 seconds. Calculate the original frequency of 'A'.
10. Calculate the frequency of the fundamental note of a string, 1 metre long and weighing 2 gms when stretched by a weight of 400 kg.
11. The intensity of sound is  $5 \times 10^{-5} \text{ Wm}^{-2}$ . If the frequency is 1000 Hz, calculate the amplitude of sound in air at STP. Given velocity of sound in air at STP is  $332 \text{ ms}^{-1}$  and density of air is  $1.29 \text{ kgm}^{-3}$ .
12. In an Poiseuille's experiment to find the coefficient of viscosity of water 8.1 cc of water was found to flow per minute through a horizontal capillary tube of length 10 cm and diameter 1 mm. If the head of water was 5.6 cm, find the coefficient of viscosity. Given  $g = 9.8 \text{ ms}^{-2}$ ,  $S = 1000 \text{ kgm}^{-3}$ .
13. Calculate the highest order spectrum for normal incidence which may be seen with monochromatic light of wavelength  $6000 \times 10^{-10} \text{ m}$  by means of a diffraction grating having  $6 \times 10^5$  lines per metre.
14. Determine the concentration of a solution of length 0.25 m which produces an optical rotation of  $30^\circ$ . The specific rotation of the solution is  $0.0209 \text{ rad m}^2 \text{ kg}^{-1}$ .
15. Calculate the probability that in tossing a coin 5 times, we get 3 heads and 2 tails.
16. The number of conduction electrons per c.c. is  $24.2 \times 10^{22}$  in beryllium and  $0.91 \times 10^{22}$  in cesium. If the fermi energy of conduction electrons in beryllium is 14.44 eV, calculate that in cesium.

PART – C

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

(10 × 2 = 20)

17. (a) When is the amplitude of the resultant motion twice the amplitude of one of the oscillations?
- (b) Does the resultant vibration of a particle depend on the phase difference?
- (c) Can stationary waves in a medium transport energy? Why?
- (d) What is resonance? Explain.
- (e) Mention the factors on which surface tension depends.
- (f) Does viscosity of liquid change with temperature? Explain.
- (g) Coloured spectrum is seen when we look through a muslin cloth. Explain.
- (h) How does the intensity of the central maximum vary with decrease in the width of the single slit in Fraunhofer diffraction?
- (i) Can sound waves be polarized? Explain.
- (j) Define microstate and macrostate.
- (k) How does the occupation number in M-B statistics for a given energy? State vary as the temperature (i) increases (ii) decreases.
- (l) What are fermions? Give an example.