TDC (CBCS) Even Semester Exam., 2022

PHYSICS

(Honours)

(2nd Semester)

Course No. : PHSHCC–202T

(Waves and Optics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer any *ten* questions : 2×10=20

1. What is simple harmonic motion? What is the necessary condition of a particle executing SHM?

2. Distinguish between longitudinal and transverse waves.

3. Show that $y = f(ct + x)$ is a solution of the wave equation

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 y}{\partial t^2}$$

where c is the wave velocity.

4. Distinguish between stationary and progressive waves.

5. What is phase velocity? Why is it also called wave velocity?

6. What is group velocity? Under what condition group velocity is equal to the phase velocity?

7. Explain the origin of colour in thin films.

8. What are the conditions necessary for observing the sustained interference pattern of light?

9. What is meant by temporal and spatial coherence?

10. What is Fraunhofer and Fresnel class of diffraction?

11. Mention the differences between interference and diffraction pattern.

12. What is Rayleigh's criterion for resolution?

13. What are Fresnel integrals?

14. State the basic difference between a conventional photograph and a hologram.

15. Explain Fresnel's half-period zones for plane waves.

SECTION—B

Answer any *five* questions : 6×5=30

16. *(a)* State and prove the principle of superposition and explain its linearity. 3

(b) Obtain the expression for pressure at different points in longitudinal waves. 3

17. A particle is subjected simultaneously to two SHMs of the same period but of different amplitudes and phases in perpendicular direction. Find the expression for the resultant motion. For what condition, the path may be straight line, ellipse and circle? 3+3=6

18. *(a)* Derive the expression for Newton's formula for velocity of sound. Explain Laplace's correction. 4

(b) If the velocity of sound in hydrogen be 1300 m/s at a certain temperature, what will be the velocity at the same temperature in a diatomic gas of molecular weight 32? 2

19. *(a)* Find the expression for group velocity and hence find the relation between group velocity and phase velocity. 3+2=5

(b) What is meant by dispersive medium? 1

20. Explain the formation of Newton's rings in reflected monochromatic light. How can we determine the refractive index of a liquid using Newton's rings? 4+2=6

21. *(a)* What is meant by fringes of equal thickness and fringes of equal inclination? Give examples. 3

(b) Explain Stokes' law for the phase change, when reflection takes place at the surface of a denser medium. 3

22. Explain how Michelson interferometer can be used to measure *(a)* the wavelength of monochromatic light and *(b)* the difference in wavelengths between the *D*-lines of sodium light. 3+3=6

(Continued)

23. What is meant by resolving power and limit of resolution of an optical instrument? Find the expression for resolving power of a diffraction grating. 1+1+4=6

24. What is zone plate? How is it constructed? Explain its theory and compare its working to that of a convex lens. 1+1+4=6

25. Explain the principle of holography. How can a hologram be recorded? Explain the formation of real and virtual images from a recorded hologram. 2+2+2=6

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