

Bihar Engineering University, Patna
B.Tech. 2nd Semester Special Examination, 2024

Course: B.Tech.
Code: 103201

Time: 03 Hours
Full Marks: 70

Subject: Physics (Waves & Optics and Introduction to Quantum Mechanics)

Instructions:-

- (i) The marks are indicated in the right-hand margin.
(ii) There are **NINE** questions in this paper.
(iii) Attempt **FIVE** questions in all.
(iv) Question No. 1 is compulsory.

Q.1 Choose the correct answer of the following (Any seven question only): **[2 x 7 = 14]**

- (a) In an object executing SHM, acceleration is proportional to
(i) Velocity (ii) Amplitude (iii) Displacement (iv) (Velocity)²
- (b) The ratio of the velocity of light in a medium to the velocity of light in a vacuum is $\frac{4}{5}$. If the ray of light is emerging from this medium into the air then the critical angle for this interface of medium and air will be
(i) 30° (ii) 37° (iii) 53° (iv) 45°
- (c) The resolving power of grating depends on
(i) Only order of diffraction
(ii) Only number of rulings per inches
(iii) Both order of diffraction and number of rulings per inches
(iv) none of the above
- (d) The wave front originated from a line source is
(i) Plane (ii) Cylindrical (iii) Spherical (iv) None of these
- (e) Which of the following laser is NOT a four level system?
(i) Ruby Laser (ii) He Ne Laser
(iii) CO₂ Laser (iv) Nd YAG Laser
- (f) Hamiltonian operator represents
(i) Momentum (ii) Position (iii) Energy (iv) Probability
- (g) The life time of electron in metastable state is of the order of
(i) 10⁻⁹s (ii) 10⁻³s (iii) 10⁻⁸s (iv) 10⁻⁷s
- (h) Fermi level of an intrinsic semiconductor is
(i) in conduction band
(ii) in valence band
(iii) in the boundary of valence band and forbidden energy gap
(iv) in halfway of valence and conduction band
- (i) A stretched string of length l fixed at both ends can sustain stationary waves of wavelength
(i) $\frac{n}{2l}$ (ii) $\frac{2l}{n}$ (iii) $\frac{l}{2n}$ (iv) $\frac{l}{n}$
- (j) The eigen value of a particle in one dimensional potential box of length 'a' is
(i) $E_n = \frac{n^2 h^2}{8ma^2}$ (ii) $E_n = \frac{n^2 m h^2}{8a^2}$ (iii) $E_n = \frac{m h^2}{8n^2 a^2}$ (iv) $E_n = \frac{8a^2 m h^2}{n^2}$

- Q.2** Write and solve the differential equation of mechanical forced damped harmonic oscillation. [14]
- Q.3** Explain the transverse waves in a stretched string, Solve the differential equation to get displacement. [14]
- Q.4** Explain the construction and working of Michelson Interferometer. How is it used to determine wavelength of monochromatic light? [14]
- Q.5** Discuss solution of stationary state Schrodinger equation for one dimensional problems of particle in a box. [14]
- Q.6** (a) Explain construction and working of Ruby Laser. Draw its energy diagram. [10]
(b) Write down applications of laser in various fields [4]
- Q.7** Derive time dependent and time independent Schrodinger equation for wave function. [14]
- Q.8** State and prove Bloch's Theorem for a particle under periodic potential [14]
- Q.9** Write short notes on *any two* of the following: [7x2=14]
(a) Total internal reflection
(b) Resolving power of grating
(c) Temperature dependence of carrier concentration of a semiconductor
(d) Zero point energy of a linear harmonic oscillator.

