Code : 103201

B.Tech 2nd Semester Exam., 2019

(New Course)

PHYSICS

(Waves and Optics, and Introduction to Quantum Mechanics)

Time : 3 hours *Full Marks* : 70

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.*

(v) Symbols used (if any) have their usual meanings.

1. Answer any *seven* questions of the following : 2×7=14

(a) Write down the equation of mechanical simple harmonic oscillator.

(b) What do you mean by standing waves?

(c) It is desired to use a plate of glass to obtain polarized light. If the refractive index of glass is 1·5, what is the polarizing angle?

(d) What is Rayleigh criterion for limit of resolution?

(e) Define Huygens' principle.

(f) Define population inversion.

(g) Write down time-dependent Schrödinger wave equation.

(h) Define Fermi level.

(i) What are intrinsic semiconductors?

(j) Write down normalized wave function of a particle in a box of length L.

2. Discuss the case of damped simple harmonic motion. Also discuss the cases of heavy damping and critical damping. What is the quality factor of a damped simple harmonic oscillator? 6+6+2=14

3. Write short notes on the following : 5+5+4=14

(a) The wave equation on a string

(b) Impedance matching

(c) Acoustics waves

4. Derive Fresnel equations. Define reflectance and transmittance. 8+6=14

5. Write short notes on : 7+7=14

(a) He-Ne laser

(b) Ruby laser

6. Showing neat ray diagram, discuss Newton's rings experiment. Derive the expression for diameter of dark rings in Newton's ring. 6+8=14

7. Discuss Heisenberg uncertainty principle. Also discuss the application of uncertainty principle in non-existence of electron in the nucleus. 6+8=14

8. Define Bloch's theorem for particles in a periodic potential. Discuss Kronig-Penney model in detail. 4+10=14

9. Derive an expression of intensity for Fraunhofer diffraction from a single slit. Also discuss the cases of the maxima and minima. In a single-slit diffraction setup, screen is placed 2 m away from the lens to obtain diffraction pattern. If the slit width is 0·2 mm and the first minimum lies 5 mm on either side of the central maxima, find the wavelength of the light. 5+5+4=14

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