Roll No. | | | | | | | | | | | | | **Total No. of Pages: 02**

Total No. of Questions: 09

B.Tech (Sem. – 1,2)

OPTICS AND MODERN PHYSICS

Subject Code: BTPH-102-18

M Code: 75354

Date of Examination : 20-01-23

Time: 3 Hrs. **Max. Marks: 60**

INSTRUCTIONS TO CANDIDATES:

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION - B & C have FOUR questions each, carrying EIGHT marks each.**
3. **Attempt any FIVE questions from SECTION B & C, selecting atleast TWO questions from each of these SECTIONS B & C.**

SECTION-A

1. Write briefly:

   a) Give the basic difference between simple, damped and forced mechanical oscillations.

   b) How to get a standing wave and what are the characteristics?

   c) How it was proved from the wave equation that light is an electromagnetic wave?

   d) Differentiate between interference and diffraction of light.

   e) Write the properties of laser light.

   f) Derive the wave function of a particle in terms of its energy (E) and momentum (p).

   g) Explain Born interpretation of probability.

   h) What is free electron theory of metals?

   i) What are the types of electronic materials?

   j) Differentiate between intrinsic and extrinsic semiconductors giving examples.

SECTION B

2. a) Write the differential equation for a forced harmonic oscillator and solve it for special cases of forced oscillatory motion.

   b) Find the maximum velocity and acceleration of a particle executing SHM of period 10π second and amplitude 5×10^{-2}m. (5+3)

3. a) Using the wave equation on a string, derive the reflection and transmission coefficients of wave at a boundary.

   b) Differentiate between longitudinal and transverse waves. (5+3)

4. a) Make a comparison between Fresnel and Fraunhofer diffractions.

   b) Discuss the phenomena of Fraunhofer diffraction at a single slit and show that the relative intensities of the successive maximum are nearly $1:\frac{4}{9}\pi^2:\frac{4}{25}\pi^2:\frac{4}{49}\pi^2$ (3+5)

5. a) Explain radiation on the basis of Einstein's theory and derive a relationship between Einstein's coefficients of radiation.

   b) Explain the construction, working and energy diagram of He-Ne laser. (4+4)

SECTION-C

6. a) What are the characteristics of a well-behaved wave function?

   b) Derive time-dependent and time independent Schrodinger wave equation for a particle. (2+6)

7. a) Solve time-independent Schrodinger wave equation for a particle in a 1-dimensional box to derive expressions for its Eigen functions and Eigen-energy values.

   b) Compute the energy of the lowest three levels for an electron in a square well of width 3Å. (6+2)

8. a) Define Fermi level.

   b) What is the density of state? How it is different in 1,2 and 3 dimensions?

   c) Determine the average energy and speed of an electron at its mean energy at 0K, if the Fermi energy is 10eV. (2+4+2)

9. Write short notes on the following:

   a) Carrier generation and recombination

   b) Carrier transport

   c) p-n junction (3+2+3)

NOTE : Disclosure of Identity by writing Mobile No. or Marking of passing request on any paper of Answer Sheet will lead to UMC against the Student.