

## SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

## School of Physics

B. Tech. 1<sup>st</sup> Semester, Major Exam

## Course Title: Engineering Physics

Course Code: PHL 1012

Time: 3hr

Total Marks: 50

Date: 27-12-2023

*Note: Attempt any 04 questions from section B. Each question carries 10 marks***Section A:****Q. No.1:** Choose the correct option of the following:

i) The idea of dual nature of light for all microscopic particles was given by: [10 Marks]

- a) Planck                      b) Einstein                      ☒ c) de-Broglie                      d) none of these

ii) For relativistic motion of a particle, the phase velocity will be equal to

- ☒ a)  $c$                       ☒ b)  $v/2$                       c)  $2c/v$                       d)  $2v/c$

iii) Schrodinger wave equation is applicable to

- a) non-relativistic motion   ☒ b) relativistic motion   c) neither for a nor b   d) both a and b

iv) Who observed that a time varying magnetic field gives rise to an electric field?

- ☒ a) Maxwell                      b) Ampere                      c) Oersted                      d) Faraday

v) Maxwell corrected which one of the following laws?

- ☒ a) Ampere's                      b) Faraday's                      c) Gauss'                      d) None of these

vi) Conductivity of insulator is

- a) high                      ☒ b) low                      c) variable                      d) None of these

vii) Position of Fermi level in intrinsic semiconductor is

- a) Below the conduction band                      ☒ b) Above valance band  
c) Midway of the conduction and valance bands                      d) None of these

viii) In Compton effect, the maximum change in wavelength will be for photo scattering at an angle

- a)  $0^\circ$                       b)  $90^\circ$                       c)  $180^\circ$                       ☒ d)  $45^\circ$

ix) In Davisson-Germer experiment, intensity was maximum for accelerating voltage equal to

- a) 50                      ☒ b) 54                      c) 30                      d) 70

x) Lorentz force is based on

- a) Dot product                      b) Cross product  
☒ c) Both dot and cross products                      d) Independent of both dot and cross products

**Section B:**

**Q. No.2:** (a) Solve time independent Schrodinger's equation for a particle in one dimensional box. Show that its energy is given as:

$$E = \frac{n^2 \pi^2 \hbar^2}{2ml^2} \quad [7 \text{ Marks}]$$

(b) Prove the commutator  $[x, p] = i\hbar$ , where x and p, are position and momentum operators.

[3 Marks]

**Q. No. 3:** (a) Find the magnetic field, both inside and outside the wire, if the current is distributed in such a way that J is proportional to s, the distance from the axis.?

[6 marks]

(b) Obtain the differential form of faradays law  $\nabla \times \mathbf{E} = - \frac{\partial \mathbf{B}}{\partial t}$  and write its integral form

[4 Marks]

**Q. No. 4:** Suppose the electric field in some region is found to be  $\vec{E} = kr^3 \hat{r}$ , in spherical coordinates (k is some constant)

(a) Find the charge density  $\rho$

[6 Marks]

(b) Find the total charge contained in a sphere of radius R, centered at the origin.

[4 Marks]

**Q. No.5:** (a) Obtain the time-dependent and time-independent Schrödinger wave equation for a particle

[5 Marks]

(b) Classify metals, semiconductors and insulators on the basis of energy bands in detail

[5 Marks]

**Q. No.6:** (a) Explain Compton effect and obtain expression for change in wave length in Compton effect.

[5 Marks]

(b) Explain Drude Lorentz free electron theory in detail?

[5 Marks]