GLA University, Mathura
Ist Term Examination, 2012-13

Set - D

Course: B.Tech (I-Year) **Semester - II**
Subject: Physics - II (AHP-102) **Uni. Roll No.....**
Time: $1\frac{1}{2}$ Hours **Total Marks: 20**

Notes:

1) Answer all questions, **Section A** is **compulsory**, **Any Two** from **Section B** and **Any Two** from **Section C**.
2) All parts of a question (a, b, etc.) should be answered at one place.
3) Answer should be brief and to-the-point and be supplemented with neat sketches.
4) Any missing or wrong data may be assumed suitably giving proper justification.
5) Figures on the right-hand side margin indicate full marks.

Section A

Attempt all parts of this question. **$8 \times 0.5 = 4$**

Q.1(i) Which of the following pairs of the phenomena illustrate the particle aspect of the wave particle duality ?

- Compton effect and Photoelectric effect
- Compton effect and diffraction
- Photoelectric effect and polarisation
- Compton effect and interference

Q.1(ii) Of the following particles moving with same velocity, the one which has largest wavelength is

- a proton
- an Sodium atom
- an electron
- an α – particle

Q.1(iii) Uncertainty relation cannot hold for

- Position and linear momentum
- linear momentum and time
- energy and time
- angular momentum and angular displacement

Q.1(iv) Phase velocity(v_p) of the de-Broglie wave associated with a particle moving with velocity v is given by (here c is the velocity of light)

- $v_p = c^2v$
- $v_p = c^3/v^2$
- $v_p = c^4/v^3$
- $v_p = c^2/v$

Q.1(v) A particle having the wavefunction $\psi = Ax$ is moving between x = 0 to x = 1along x-axis. The normalized wavefunction of this particle would be

- $\psi = (3)^{1/2}x$
- $\psi = (2)^{1/2}x$
- $\psi = (3)^{1/2}x^2$
- $\psi = (3)^{1/3}x$

Q.1(vi) The least kinetic energy of a proton moving (freely) in a one dimension in an infinite high potential box of width 1 Å

- 6.03×10^{-18} Joule
- 13.16×10^{-23} Joule
- 3.29×10^{-21} Joule
- 2.42×10^{-17} Joule

Q.1(vii) Bragg's diffraction occurs with

- sound waves
- x-rays
- light rays
- both with sound waves and light rays

Q.1(viii) Compton shift is maximum at scattering angle (θ) equal to

- 90^0
- 45^0
- 0^0
- 180^0

Section - B

Attempt any two questions. **$3 \times 2 = 6$**

Q.1 A particle of rest mass m_0 has relativistic kinetic energy K. Show that its de- Broglie wavelength is given by the expression

$$\lambda = hc\{K(K+2m_0c^2)\}^{-½}$$

Calculate the wavelength of matter wave associated with an electron of kinetic energy 1 MeV.

Q.2 State uncertainty principle. What is the uncertainty in the position of wavelength 5000 Å if this wavelength is known to an accuracy of one part in a thousand?

Q.3 What is wavefunction? Derive Schrodinger time dependent equation.

Section - C

Attempt any two questions. **$5 \times 2 = 10$**

Q.1 Define phase velocity and group velocity. Establish the relation between phase velocity and group velocity in dispersive medium. Prove that the group velocity is equal to the velocity of the particle.

Q.2 A particle is moving in a one dimensional rigid box of length L. The potential energy (V) of this particle is as follows

$V = \infty$, for $x \leq 0$ and $x \geq L$

$V = 0$, for $0 < x < L$

Solving the Schrodinger equation obtain the energy eigen values and normalized wavefunction for the particle.

Q.3 What is Compton shift ? Derive an expression for Compton shift and explain very briefly that it does not depend upon the nature of the material and wavelength of incident radiation.

Physical constants

Plank's constant (h) = 6.63×10^{-34} Joule Second
Speed of light(c) = 3×10^8 m/s
Mass of electron (m) = 9.1×10^{-31} Kg
Mass of proton = 1.67×10^{-27} kg