

May 2023, Reappear
B.Sc (H) Physics, IV SEMESTER
Elements of Modern Physics

Time: 3 Hours

Max. Marks:75

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.
 4. Use of non-programmable simple calculator is allowed.

PART -A

- Q1 (a) Explain why electron do not exist in nucleus using uncertainty principle.. (1.5)
- (b) What are canonical conjugate pairs? (1.5)
- (d) Find the mass number A of a nucleus having radius 3.46 fm. (1.5)
- (d) What are magic numbers and why they are so called? (1.5)
- (c) What is energy equivalent of 1 amu? (1.5)
- (f) Find the intensity of a laser beam of 100mW power and having a diameter of 1.3 m. Assume the intensity to be uniform. (1.5)
- (g) What are conditions for a wave function to be acceptable. (1.5)
- (h) What is momentum of an electron if its de Broglie wavelength is 1\AA ? (1.5)
- (i) Explain the significance of Carbon cycle in the fusion reaction inside stars. (1.5)
- (j) What is linear operator? Is cosine a linear operator? (1.5)

PART -B

- Q2 (a) What is the Compton effect? Show that the change in wavelength in Compton scattering is independent of the incident wavelength. (8)
- (b) Light of wavelength 3000\AA falls on a metal surface having a work function of 2.3 eV. Calculate the maximum velocity of the ejected photoelectron. (7)
- Q3 (a) Solve the Schrodinger equation for a particle in a one-dimensional rigid box of width L and obtain its eigenvalues. Discuss the probability of finding the particle at various points in different quantum states. (8)
- (b) Find the relation between group velocity and phase velocity for dispersive as well as non-dispersive medium. (7)
- Q4 (a) Describe two opposing forces between particles in the nucleus. Plot N-Z graph and explain why the ratio of neutrons to protons required for a stable nuclide increases with increasing number of protons in a nucleus. (8)
- (b) State the law of radioactive decay. If 99% of a radioactive element disintegrates in 36 hours. What is the half -life of this isotope? (7)
- Q5 (a) What are Einstein's coefficients A & B? Derive relation between them. Discuss their significance in context of laser operation. (8)
- (b) What is a laser? Discuss the construction and working of a He-Ne laser. How is it superior to Ruby laser? (7)

- Q6 (a) Discuss the neutrino hypothesis for the emission of beta particles from a nucleus. In what way is the energy spectrum of beta emission different from that of alpha emission. (8)
- (b) What do you mean by tunnel effect? Give any two examples of tunneling. Why is it a quantum-mechanical phenomenon? (7)

Q7 Write short notes on:

- (a) Gamma emission (5)
- (b) Internal conversion (5)
- (c) Pair production (5)
