6. (a) Explain the role of meta stable state in lasing action. Draw schematic and comment on 'what will happen in the absence of meta stable state?' (7)

(b) Can pair production occur in empty space? Justify your answer. (8)

7. (a) Why the neutrino should exist and how was it discovered? Explain this in the light of theory of beta decay. (7)

(b) What is the difference between monochromaticity and directionality? Is it possible to get absolute monochromaticity in the laser light? What is the reason behind it? (8)

Roll No. ..... Total Pages : 4

321402

May, 2023

B.SC.(PHYSICS)- IV SEMESTER

Elements of Modern Physics(BPH-402A)

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.*

PART-A

1. (a) What do you mean by 'superposition principle'? Explain its importance in view of Young's double slit experiment. (1.5)

(b) An electron has a speed of 4×10^5 m/s accurate to 0.01%. With what fundamental accuracy can we locate the position of the electron? (1.5)

(c) Why is normalization of a wave function a stringent requirement for choosing a possible wave function for a physical problem? (1.5)

(d) What will happen to the photoelectric current if you increase the frequency of the light but keep the intensity constant. Explain with the help of a graph. (1.5)

(e) Define coherence of light. Comment on the possibility of coherent sources. (1.5)

(f) How is emission of Beta-particles from radioactive nuclei even possible when they are not contained in the nuclei? (1.5)

(g) Determine the ratio of nuclear radii of C-12 and 0-16. (1.5)

(h) Explain the impossibility of an electron being in the nucleus as a consequence of the uncertainty Principle (1.5)

(i) The work function of potassium is 2 eV. When the UV light of wavelength 3500 Å falls on its surface, calculate maximum kinetic energy of emitted photoelectron in eV. (1.5)

(j) Explain one process where quantum mechanical tunneling is observed. (1.5)

PART-B

2. (a) Derive Einstein's photoelectric equation. Explain how work function of a metal is related to the maximum kinetic energy of a photoelectron. (10)

(b) Calculate the binding energy in MeV per nucleon for $5B^{10}$ with mass number10.0161 a.m.u. Given that mass of a proton is 1.0081 a.m.u. and mass of a neutron is 1.008 a.m.u. (5)

3. (a) Explain basic postulates of quantum mechanics and their importance. (5)

(b) Obtain the value of transmission co-efficient and reflection coefficient quantum mechanically for a potential step. Explain the factors on which they depend upon. (7)

(c) Show that de Broglie wavelength associated with an electron of energy V electron-volts is approximately $(1.227/\sqrt{V})$ nm. (3)

4. (a) Discuss the absorption, spontaneous emission and stimulated emission. Define and derive Einstein's A and B coefficients. (8)

(b) Describe nature of nuclear forces with the help of N-Z graph. What is the role of neutron number in the stability of the nucleus? (7)

5. (a) The life time of an excited state of an atom is about 10^{-8}s. Calculate the minimum uncertainty in the determination of the energy of the excited state. (7)

(b) One gram of Ra-226 has an activity of 1 curie. Determine the half-life of Ra-226. Given Avogadro's number = 6.023×10^{23}. (8)