B.Sc. T.Y. CBCS Pattern Semester-V

USDSEPHT09 - Physics Paper-I (Elements of Modern Physics)

P. Pages : 3 **GUG/W/23/13093**

Time : Three Hours * 5 0 9 4 * Max. Marks : 50

Notes : 1. All questions are compulsory.
2. Draw neat and well labelled diagrams wherever necessary.

Either:-

1. a) i) Describe in detail Davisson-Germer experiment to verify de-Broglie hypothesis. **4**

ii) What are the salient features of black body radiation spectrum? **2**

iii) State de-Broglie's hypothesis for matter waves. Express de-Broglie's equation in terms of energy. **2**

iv) Calculate de-Broglie wavelength of an electron whose kinetic energy is 400 eV. (Given, $h = 6.64 \times 10^{-34}$ J.S) **2**

OR

b) a) State and explain Heisenberg's uncertainty principle. **2½**

b) Show that electron cannot be present inside nucleus on the basis of uncertainty principle. **2½**

c) Explain the concept of wave particle duality. **2½**

d) An electron of mass 9.1×10^{-31} kg has a speed of 5.5×10^{4} m/s with an accuracy 0.02%. Calculate the uncertainty with which the position of electron can be located. **2½**

Either:-

2. a) i) Obtain an expression for quantized energy for an electron trapped in one dimensional potential well of infinite height of width L. **4**

ii) State the conditions for a wave function to be well behaved. **3**

iii) The lowest energy possible for a certain particle entrapped in a box is 40 eV. What are the next three higher energies the particle can have? **3**

OR

b) a) Explain in short the phenomenon of the tunneling that occurs when a beam of particles are incident on a potential barrier of finite width. **2½**

b) What is eigen function and eigen value? Explain them with example. **2½**

c) State and Explain Momentum and Energy operators in quantum mechanics. **2½**

d) Explain stationary states. **2½**

Either:-

3. a) i) Explain in detail Gamow's theory of α - decay. **5**

ii) What is binding energy? Explain how the stability of nucleus can be checked with the help of B-E per nucleon curve. **2**

iii) Calculate the binding energy of an α particle in joules and in Mev from the following data. **3**
M_{He} = 4.002870 amu, m_p = 1.007825 amu, m_n = 1.008665 amu,
1 amu = 14.92×10^{-11} J = 931.48 MeV.

OR

b) a) What is α - decay? Give its characteristics. **2½**

b) Describe nature of nuclear forces. **2½**

c) Explain the different properties of nucleus. **2½**

d) Calculate the mass number of the nucleus whose radius is **2½**
i) 4.8×10^{-15}m and ii) 3.66×10^{-15} m. (Given $r_0 = 1.3$ fm)

Either :-

4. a) i) Explain in detail construction and working of nuclear reactor. **5**

ii) What is chain reaction? How is it obtained? **2**

iii) Calculate the energy liberated when a helium nucleus is formed by fusion of two deuterium nuclei. The mass of H_2 = 2.01478 amu and mass of $^4_2He = 4.00388$ amu. **3**

OR

b) a) Explain the various stages in the fission process as given by the liquid drop model. **2½**

b) Explain β -ray spectrum. **2½**

c) Explain why fusion reactions are called thermonuclear reactions? **2½**

d) Calculate the amount of energy released when 1 kg of $^{235}_{92}U$ undergoes fission Reaction, taking disintegration energy per event to be Q = 208 MeV. **2½**

5. Solve **any ten** of the followings

a) Give at least any two properties of photons. **1**

b) What is photoelectric effect? **1**

c) Write down relation for energy-time uncertainty. **1**

d) Write Schrodinger's time independent and time dependent wave equations. **1**

e) What is normalized wave functions? **1**

f) what is an operator? **1**

g) Define range of α -particle. **1**

h) Give the important characteristics of the nuclear forces. **1**

i) Define mean life & half – life. **1**

j) What is 'Stellar energy'? **1**

k) What is Mossbauer Effect? **1**

l) What are limitation of liquid drop model? **1**

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