B.Sc. T.Y. (CBCS Pattern) Semester - V
USDSEPHT-09 : Physics Paper-I (Elements of Modern Physics)

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

Either:

1. a) i) State and explain Heisenberg's uncertainty principle. **2**

ii) Describe the gamma rays microscope experiment to prove the Heisenberg's uncertainty principle. **6**

iii) An electron is confine to a box of length 10^{-8} m calculate the minimum uncertainty in its velocity. Given $Me = 9 \times 10^{31}$ kg $h = 6.63 \times 10^{-34}$ JS. **2**

OR

b) a) What are the silent features of black body radiation spectrum? **2½**

b) Calculate De-Broglie wavelength of proton which has kinetic energy of 1Mev. Mass of proton is 1.67×10^{-27} kg. **2½**

c) What is photoelectric effect. Explain failures of classical mechanics w.r.t. photoelectric effect. **2½**

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

Either:

2. a) i) State the boundary condition for a free particle in one dimensional box. **2**

ii) Write Schrodinger's wave equation for a free particle in one dimensional box and solve it and obtain eigen value of momentum and energy for it. **6**

iii) State the value of momentum and energy in one dimensional box with impenetrable walls. Find their values for an electron in a box of length 1A° for n = 1, Mass of electron is 9.1×10^{-31} kg and $h = 6.63 \times 10^{-34}$ JS. **2**

OR

b) a) What is wave function ψ ? Explain physical significance. **2½**

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

c) What is an operator? Mention any two quantum mechanical operator. **2½**

d) Differentiate between a potential step and potential barrier. Give physical example in each case. **2½**

Either:

3. a) i) Explain the concept of potential well. **2**

ii) Explain in details account of Gamow's theory of α – decay. **6**

iii) Explain the term atomic mass unit. Compute the energy of 1a.m.u. in MeV. **2**

OR

b) a) State the law of Radioactivity decay. Find the half life & average life of elements. **2½**

b) Write the relation between mass number and radius of nucleus and find radius of $_{13}Al^{27}$ nucleus. **2½**

c) Discuss graphically the variation of average binding energy per nucleon with mass number. **2½**

d) Explain why the sum of masses of 2 neutrons and 2 protons is not equal to the mass of α particle. **2½**

Either:

4. a) i) What are the main assumption of liquid drop model of the nucleus. **2**

ii) Obtain the expression for binding energy of nucleus based on liquid drop model and show the graph of binding energy per nucleon as the sum of volume, surface, coulomb and asymmetry energy. **6**

iii) What are merits of liquid drop model. **2**

OR

b) a) What is nuclear fusion? Explain its mechanism. **2½**

b) Calculate the energy liberated when a helium nucleus is formed by fusion of two deuterium nuclei. The mass of $_1H^2 = 2.01478$ a.m.u and mass of $_2He^4 = 4.00388$ a.m.u. **2½**

c) Explain the term thermonuclear energy and discuss its importance in universe. **2½**

d) What is massbour effect? Explain it. **2½**

5. Attempt **any ten** only.

a) What is black body radiation. **1**

b)   Draw the experimental set up for Davisson and Germer experiment.   **1**

c)   What are application of uncertainty principle.   **1**

d)   Write Schrodinger's time independent equation.   **1**

e)   What is step potential?   **1**

f)   Write quantum mechanical operator for energy.   **1**

g)   Define the range of α – particle.   **1**

h)   State semi-empirical mass formula.   **1**

i)   What is binding energy of nucleus.   **1**

j)   What are limitation of liquid drop model.   **1**

k)   What is nuclear fission.   **1**

l)   Define chain reaction.   **1**

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