B.Sc. T.Y. (CBCS Pattern) Sem-V

USDSEPHT09 - Physics Paper-I : Elements of Modern Physics

P. Pages : 2 **GUG/W/22/13093**

Time : Three Hours * 3 6 1 8 * Max. Marks : 50

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

Either:

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

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

iii) Show that electron cannot be present inside nucleus on the basis of Uncertainty principle. **3**

iv) Calculate the uncertainty in the momentum and velocity of an electron confine in box of length $1A^{o}$. **3**

OR

b) a) Describe in detail Davisson-Germer experiment to verify de-Broglie hypothesis. **2½**

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

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

d) An electron of mass 9.1×10^{-3i} kg has a speed of 1 km/s with an accuracy 0.05%. 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) What is eigen function and eigen value? Explain them with example. **3**

iii) Electron of energy 2.0eV are incident on a barrier 4.0eV high and 0.4 nm wide. Find transmission probability. **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) State the conditions for a wave function to be well behaved. **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) Explain the different properties of nucleus. **2**

iii) Calculate binding energy per nucleon of deuteron. **3**

Given $m_n = 1.675 \times 10^{-27}$ kg, $m_p = 1.672 \times 10^{-27}$ kg,

$m_D = 3.343 \times 10^{-27}$ kg, $C = 3 \times 10^8 m/sec$.

OR

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

b) Obtain an expression for Geiger – Nuttal Law from Gamow's theory. **2½**

c) What is binding – energy? Explain how the stability of nucleus can be checked with the help of B – E per nucleon curve. **2½**

d) The half life of a radioactive element is 10 days. How long will it take for 90% of the sample to disintegrate? **2½**

Either:

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

ii) Explain β-ray spectrum. **2**

iii) Calculate the energy liberated when a helium nucleus is formed by fusion of two deuterium nuclei. The mass of $H_2 = 2.014102$ amu and mass of $^4_2He = 4.002604$ amu **3**

OR

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

b) What is chain reaction? How is it obtained? **2½**

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

d) Calculate the amount of energy released when 1 kg of $^{935}_{92}U$ undergoes fission reaction. **2½**

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

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

b) State the properties of matter waves. **1**

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

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

e) Explain Physical significance of psi. **1**

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

g) Define range of α-particle. **1**

h) Write down important characteristics of the nuclear forces. **1**

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

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

k) What is Massbouereffect? **1**

l) State Geiger – Nuttle law. **1**

****