

B.Sc. T.Y. (CBCS Pattern) Semester-V
USDSEPHT09 - Physics Paper-I - Elements of Modern Physics

P. Pages : 2

Time : Three Hours



GUG/W/24/13093

Max. Marks : 50

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

Either

1. a) i) State Heisenberg uncertainty principle. Explain why it implies that a particle cannot have well-defined trajectory. 5
- ii) How does Heisenberg uncertainty principle affect the measurement of particles position and momentum simultaneously. 3
- iii) An electron is confined to a box of height 10^{-8} m. Calculate the minimum uncertainty in its velocity. (Given $m_e = 9 \times 10^{-31}$ kg and $h = 6.63 \times 10^{-34}$ Js) 2

OR

- a) Show that electron can not be present inside nucleus on the basis of uncertainty principle. 2½
- b) What are the salient features of black body radiation spectrum? 2½
- c) Explain the failure of classical theory with respect to black body. 2½
- d) Calculate De-Broglie wavelength of proton which has kinetic energy of 1 MeV. Mass of proton is 1.67×10^{-27} kg. 2½

Either

2. a) i) Obtain an expression for energy of a free particle in one dimensional rigid box. 4
- ii) What is eigen function and eigen values? Explain them with suitable example. 3
- iii) Find the lowest energy and momentum of an electron in one dimensional potential well of width 1 \AA . Express the result in eV. 3
- [Given: Mass of an electron 9.1×10^{-31} kg]

OR

- b) a) What is wave function ψ ? Explain physical significance. 2½
- b) What is an operator? Mention any two quantum mechanical operator. 2½
- c) Derive Schrodinger's wave equation in time independent form. 2½
- d) Explain stationary states. 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 1 amu in MeV. 2

OR

b) a) What is binding energy? Explain how the stability of nuclear can be checked with the help of B-E per nucleon curve. 2½

b) Explain mean life period of a radioactive element and derive an expression for it. 2½

c) Explain the different properties of nucleus. 2½

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

Either

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

ii) What is chain reaction? How is it obtained? 3

iii) Describe the construction and working of nuclear reactor. 5

OR

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

b) What is Mossbauer effect? Explain it. 2½

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

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

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

a) Draw the experimental setup for Davisson & Germer experiment. 1

b) What is wave packet? 1

c) What is black body radiation? 1

d) What is step potential? 1

e) What is normalized wave function? 1

f) Write Schrodinger time dependent wave equation. 1

g) Give the relation between half life & mean life? 1

h) Define range of α -particle. 1

i) Define half life? 1

j) What are the different properties of neutrino? 1

k) What is "Stellar energy"? 1

l) When a nuclear emits gamma ray photon, what happens to its atomic number & its actual mass. 1
