B.Sc. T.Y. (CBCS Pattern) Semester - VI

USDSEPHT13 - Physics Paper-I : Nuclear and Particle Physics

P. Pages : 3 **GUG/S/23/13365**

Time : Three Hours * 1 9 1 1 * Max. Marks : 50

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

Either:

1. a) i) Define mass defect and packing fraction. **2**

ii) Explain the concept of Nuclear magnetic dipole moment. What is nuclear magneton? **3**

iii) Discuss electric quadrupole moment of nucleus. **3**

iv) Find the nuclear radius of $_{30}Zn^{64}$ (Given $R_0 = 1.2 \times 10^{-15} m$) **2**

OR

b) a) Discuss magnetic moment of an atom. What is Bohr's magneton. **2½**

b) Prove that nuclear density is same for all nucleus. **2½**

c) Discuss various properties of nucleus. **2½**

d) Calculate the ratio of nuclear radius of lead $_{82}Pb^{204}$ and silver isotope $_{47}Ag^{107}$. **2½**

Either:

2. a) i) Give the main assumption's of shell model and liquid drop model. **4**

ii) Explain Fermi gas model. **2**

iii) Discuss the concept of nuclear stability. **2**

iv) Explain the concept of nuclear force. **2**

OR

b) a) How does the shell model explains the existence of magic number 2, 8, 20 & 28 only. **2½**

b) Derive the expression for binding energy of nucleus, based on liquid drop model. **2½**

c) Explain the concept of two nucleon separation energy. **2½**

d) Find ground state spin for $_{21}Sc^{45}$ using shell model. **2½**

Either:

3. a) i) What is nuclear reaction? Explain various types of nuclear reactions. **3**

ii) Discuss various conservation laws in nuclear reactions. **2**

iii) Derive an expression for Q-value of the reaction X (a, b) Y in terms of kinetic energy. **3**

iv) The Q-value of $Na^{23}(n,\alpha)F^{20}$ reaction is – 5.4 MeV. Determine the threshold energy of this reaction. **2**
Given : Mass of Neutron = 1.00866 a.m.u2
Mass of Na^{23} = 22.9909 a.m.u.

OR

b) a) Explain the terms Range and Straggling of a charged particle. **2½**

b) Explain the interaction of neutron's with matter. **2½**

c) Discuss the interaction of gamma ray with matter. **2½**

d) Show that the reaction $Li^{7}(p,\alpha)He^{4}$ is Exothermic. **2½**
Given:
Atomic mass of $_1H^1 = 1.00814$ a.m.u., $_2He^4 = 4.00260$ a.m.u., $_3Li^7 = 7.01822$ a.m.u. .

Either:

4. a) i) Discuss the variation of ionization current with applied voltage due to passage of charged particles through the ionization detector. **3**

ii) Describe construction and working of GM Counter. **3**

iii) Explain working of photomultiplier. **2**

iv) If the frequency of oscillator potential applied to the dees of the cyclotron is 9 MHz. What must be the magnetic flux density to accelerate the $\alpha-$particles? **2**
Given : Mass of $\alpha-$particle = 6.643×10^{-27} kg
Charge on $\alpha-$particle = 3.204×10^{-19} C

OR

b) a) Explain construction and working of linear accelerator. **2½**

b) Derive the resonance condition of cyclotron? What are limitations of cyclotron? **2½**

c) Describe the working of Van-De-Graft Generator. **2½**

d) What would be the length of last drift tube in a linear accelerator which produces energy 120 MeV C^{12} ions, using frequency of 70 MHz. **2½**
Given : 1eV =1.6×10^{-19} J, 1amu =1.66×10^{-27} kg

5. Attempt **any ten** questions from followings carries 1 mark.

a) Define atomic mass unit. **1**

b) Write the formula for Nuclear Magneton. **1**

c) What is the energy equivalent of 1 a.m.u. **1**

d) Why do the protons in the nucleus not fly apart? **1**

e) What do you mean by charge independence of nuclear force? **1**

f) What are the limitations of liquid drop model? **1**

g) Write Neil's – Bohr's formula. **1**

h) What is Endoergic and Exoergic reaction? **1**

i) Define the term nuclear reaction cross section. **1**

j) State the limitations of linear accelerator. **1**

k) What is mean by threshold voltage in GM tube? **1**

l) Write the principle of ionization chamber. **1**

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