B.Sc. Third Year CBCS Pattern Semester-VI

USDSEPHT13 - Physics Paper-I : Nuclear and Particle Physics

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

Time : Three Hours * 6 7 6 1 * Max. Marks : 50

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

Either:

1. a) i) Explain basic properties of nucleus in terms of Nuclear size, mass, charge & density. **4**

ii) What do you mean by mass defect & binding energy of nucleus. Draw & explain the graph of binding energy per nucleon versus mass number. **4**

iii) Calculate the binding energy of an $\alpha-$ particle from the following data. **2**
Mass of helium nucleus = 4.002870 u
Mass of proton = 1.007825 u
Mass of neutron = 1.008665 u. & 1u = 931.5 MeV.

OR

b) i) Explain spin, orbital & total angular momentum of nucleons. **2½**

ii) Derive an expression for magnetic moment of an atom. **2½**

iii) Explain packing fraction & its variation with mass number. **2½**

iv) Find the binding energy of deuteron from the following data: **2½**
$m_p = 1.007276\,u,\ m_n = 1.008665\,u,$ & $M_N = 2.013553\,u$.

Either:

2. a) i) Obtain an expression for binding energy of a nucleus on the basis of liquid drop model. **5**

ii) State the main assumptions of shell model of the nucleus. Write its merits & failures. **5**

OR

b) i) Discuss the origin & concept of nuclear forces. **2½**

ii) Give the main assumptions of liquid drop model of the nucleus. **2½**

iii) What are magic numbers of nuclei? How does the shell model explain the existence of magic numbers 2, 8, 20 & 28 only? **2½**

iv) Explain fermi gas model of the nucleus. **2½**

Either:

3. a) i) Explain various types of nuclear reactions, which may occur when a high energy particle approaches a target nucleus. **3**

ii) Derive the Neil-Bohr's formula. **4**

iii) Describe different ways by which γ-rays interact with matter. **3**

OR

b) i) Discuss various conservation laws in nuclear reaction. **2½**

ii) Define & explain Q-value of nuclear reaction. **2½**

iii) What are exothermic & endothermic nuclear reaction? Give suitable examples. **2½**

iv) Obtain Q-value of given nuclear reaction & Identify its types. **2½**

$_7N^{14}(\alpha, p)_8O^{17}$ in MeV

Given: mass of helium = 4.0026 a.m.u.

Mass of $_7N^{14}$ = 14.0031 a.m.u.

Mass of $_8O^{17}$ = 16.9991 a.m.u.

Mass of proton = 1.0078 a.m.u.

& 1 a.m.u. = 931.5 MeV.

Either:

4. a) i) Describe the principle, construction & working of Geiger-Muller counter. Explain quenching in G.M. Counter. **5**

ii) Show that the length of cylindrical electrode in linear accelerator is proportional to square root of the no. of that electrode. **3**

iii) The dead time of G.M. Counter is $400\,\mu s$. What is the true counting rate for measured counting rate 110 counts per minute? **2**

OR

b) i) Explain construction & working of scintillation counter. **2½**

ii) Explain Van-de Graaf generator **2½**

iii) Describe the construction & working of cyclotron. **2½**

iv) If the frequency of oscillator potential applied to the dee's of the cyclotron is 9MHz. What must be magnetic flux density B to accelerate the alpha particles? **2½**

(Given: mass of alpha particle = 6.643×10^{-27} kg,

charge of α- particle = 3.204×10^{-19}C)

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

a) Write constituents of nucleus. **1**

b) What is Bohr Magneton? **1**

c) Find the packing fraction of $_{30}Zn^{64}$, whose mass is 63.9291 a.m.u. **1**

d) What are the conditions of nuclear stability? **1**

e) What is the basic point of difference between the liquid drop model & shell model of the nucleus? **1**

f) State limitations of liquid drop model. **1**

g) Define cross-section of nuclear reaction. **1**

h) What is nuclear reaction? **1**

i) What is Cherenkov radiation? **1**

j) Define Dead time. **1**

k) State the principle of propositional counter. **1**

l) What are the limitations of cyclotron? **1**

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