

B.Sc. T.Y. (CBCS Pattern) Semester-VI
USDSEPHT13 - Physics Paper-I : Nuclear and Particle Physics

P. Pages : 3

Time : Three Hours



GUG/W/24/13365

Max. Marks : 50

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

Either:

1. A) i) Define Nuclear Mass and Nuclear Charge. 2
- ii) Explain spin, orbital and total angular momentum of nucleons. 3
- iii) Discuss the main features of average binding energy per nucleon versus mass number of curve. 3
- iv) Find the nuclear radius of ${}_{13}\text{Al}^{27}$ (Given $R_0 = 1.3 \times 10^{-15}$ meter). 2

OR

- B) a) Prove that nuclear density is same for all nuclei. 2½
- b) Derive the relation between atomic mass unit and electron volt. 2½
- c) Explain the term mass defect and packing fraction. 2½
- d) Calculate the mass number of nucleus whose radius is 3.66×10^{-15} m 2½
(Given: $R_0 = 1.3f_m$)

Either:

2. A) i) Give the main assumption of shell model. 3
- ii) How does the shell model explain the existence of magic number 2, 8, 20 & 28 only? 3
- iii) Explain Fermi gas model of the nucleus. 2
- iv) Write the general concept of Nuclear forces. 2

OR

- B) a) Explain the concept of nuclear stability. 2½

- b) What are the evidences for nuclear shell structure? 2½
- c) Give the main assumptions of liquid drop model. 2½
- d) Discuss the concept of two nucleon separation energies. 2½

Either:

3. A) i) What is nuclear reaction? Explain various types of nuclear reactions. 5
- ii) Define and explain the term nuclear reaction cross-section. What are its units? 2
- iii) Show by mass energy calculations, whether the nuclear reaction ${}_7\text{N}^{14}(\alpha, p){}_8\text{O}^{17}$ in MeV is exoergic or endoergic. 3
- Given: ${}_2\text{He}^4 = 4.0026\text{a.m.u.}$, ${}_7\text{N}^{14} = 14.0031\text{ a.m.u.}$, ${}_1\text{H}^1 = 1.0078\text{a.m.u.}$,
 ${}_8\text{O}^{17} = 16.9991\text{ a.m.u.}$, $1\text{ a.m.u} = 931.5\text{ MeV.}$

OR

- B) a) Discuss various conservation laws in nuclear reactions. 2½
- b) Explain the limitation of Bethe-Bloch formula in applying to the interaction of electron with matter. 2½
- c) Discuss interaction of gamma ray with matter. 2½
- d) The intensity of γ – rays passing through an aluminium absorber of thickness 20cm falls to 2% of its initial value. Calculate the mass absorption coefficient for the aluminium. Density of aluminium is 2700kg/m^3 . 2½

Either:

4. A) i) Describe the construction and working of a Geiger Muller (G.M) Counter. 3
- ii) Explain the principle construction and working of a proportional counter. 3
- iii) Explain working of Photomultiplier. 2
- iv) A G. M. Counter with dead time of 2×10^{-4} second registers 500 pulses per second. Find the flux of incoming particles per second. 2

OR

- B) a) Describe the working of Van-De-Graft Generator. 2½

- b) Describe the construction of Synchro-Cyclotron. 2½
- c) Explain the principle and construction of a linear accelerator. 2½
- d) A cyclotron with dees of radius 2 meters has a magnetic field of 0.75 wb/m^2 . 2½
 Calculate the maximum kinetic energy in MeV to which protons can be accelerated.
 (Given: Mass of Proton $m_p = 1.67 \times 10^{-27} \text{ kg}$, Charge of proton $q_p = 1.6 \times 10^{-19} \text{ Coloumb}$)

5. Attempt **any ten** questions from followings.

- a) Define nuclear charge. 1
- b) Define binding energy of a nucleus. 1
- c) Define mass-energy equivalence relation. 1
- d) What are the limitations of liquid drop model? 1
- e) What are magic numbers in nuclear structure? 1
- f) Define the success of Fermi gas model of the nucleus. 1
- g) Define radioactive capture of nuclear reaction. 1
- h) What is stopping power of the medium? 1
- i) Define the term nuclear reaction cross section. 1
- j) Define the dead time of G.M. Counter. 1
- k) Give the advantages of Scintillation Counter. 1
- l) Can neutrons be accelerate in a cyclotron? Why? 1
