Mid-West University

Examinations Management Office

Surkhet, Nepal

End Semester Examinations -2078

Bachelor level/ B.Sc /7th Semester — Full Marks : 100

Time: 3 hrs — Pass Marks : 50

Subject : Nuclear and Particle Physics (PHY 473)

Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.

You may use h=6.62x10^{-34}Js , c=3x10^{8} m/s, e=1.6 x 10^{-19} coulomb, mass of Electron= $9.1 \times 10^{-31}\ kg$,mass of proton and neutron are $1.007825\ a.m.u.$ and mass of neutron= $1.008665\ a.m.u.$

Group – A

1. **Answer in short any** Eight **questions** [8x2 = 16]
   a. What is the significance of electric quadrupole moment in nuclear physics?
   b. Explain the charge independence nature of nuclear force.
   c. Why does the ionization chamber can not detect beta and Gamma rays ? Explain.
   d. Describe in short *Mossbauer* effect.
   e. Explain in brief the nuclear spin and nuclear parity.
   f. Describe the idea of origin of natural radioactivity in short.
   g. What particles correspond to quark composition $u\bar{s}$, ddu?
   h. What are strange particles? How they were produced. Explain.
   i. What are soft and hard component of cosmic ray? Explain.

Group – B

2. **Answer any** Six **questions** [6x6= 36]

   i. How does a nuclear reaction be different from a chemical reaction. Describe the types of nuclear reaction reactions with examples.
   ii. What is meson theory of nuclear forces? Estimate the mass of meson using Heisenberg uncertainty principle.
   iii. What is the difference between nuclear fusion and fission? Draw a sketch of sustainable chain reaction with a brief description.
   iv. What is the liquid drop model? Derive the semi-empirical formula using the ideas of this model.
   v. Describe in short:latitude effect, altitude effect and east west effect of cosmic rays.
   vi. What is beta decay? Discuss the energy spectrum curve from beta decay of a radioactive nuclide. What is end point energy?
   vii. What are Elementary particles? Classify them with examples.

Group – C

3. What is betatron? Derive the betatron condition for successful acceleration of electrons. Briefly describe its principle and construction. [9]

4. Discuss the Gamow's theory of emission of - emission. How does it relate to the Geiger-Nuttallaw ? [9]

OR

Discuss the evidences to show that existence of shell structure within the nucleus? On the basis of shell model, explain the origin of magic numbers.

5. 1 gram of a radioactive substance disintegrates at the rate of 3.7×10^{10} disintegrations per second. The atomic weight of the substance is 226. Calculate its mean life. [6]

6. Find the spin-parity of ${}^{9}_{4}Be \; and \; {}^{33}_{16}Si$. [6]

7. Find the binding energy per nucleon of a helium nucleus. Given that mass of the helium nucleus = 4.001509 a.m.u. [6]

8. In an absorption experiment with 1.14 MeV gamma radiation from Zn^{65} it is found that 25 cm of Al reduces the beam intensity to 2%. Calculate the half thickness and the mass attenuation coefficient of Al for this radiation. Density of Al = 2700 kg /$m3$. [6]

OR

The precise mass in the reaction ${}_{1}H^{1} + {}_{9}F^{19} \rightarrow {}_{2}He^{4} + {}_{8}O^{16}$ have been determined by mass spectrometer and are m(H)= 1.007825 u, $m(He)$ = 4.002603 u, $m({}_{9}F^{19})$ = 18.998405u; $m({}_{8}O^{16})$ = 15.994915 u. Determine the Q and the nature of the reaction.

9. Deuteron in a cyclotron describe a circle of radius 0.32 m just before emerging from the dees. The frequency of the applied $e.m.f.$ is 10 Mhz. Find the flux density of the magnetic field and the velocity of the deuterons emerging out of the cyclotron. Mass of deuteron= $3.32 \times 10^{-27} kg$, $e = 1.6 \times 10^{-19}$ C. [6]

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