

B. Sc Physics Special Supplementary Examination, 2024

(3rd Year, 1st Semester)

Nuclear & Particle Physics

Paper: EX/SC/PHY/UG/DSE/TH/02/A1/2024(S)

Time: Three hours

Full Marks: 75

Answer any five questions

(5X15)

1. a) What do you mean by binding energy per nucleon (B.E./A) of an atomic nucleus? Where from the binding energy comes? Draw a curve to show the variation of binding energy per nucleon (B.E./A) with mass number (A) of the nucleus. Discuss what kind of information can be obtained from this curve.
[1+2+1+3]
b) Find the ratio of diameters of C-12 and Mg-24 nucleus. What is the total spin of O-16 nucleus in the ground state?
[2+2]
c) Discuss the properties of nuclear force and how is it different from electrostatic force?
[4]
2. a) Draw alpha and beta energy spectrum. Why are they different? Write down the equations for β^- , β^+ and electron capture processes.
[2+3+3]
b) What are the processes by which a gamma beam is attenuated in a material? Which processes is predominant at low energies and how its probability varies with energy? Among the other processes which one has energy threshold for its occurrence and why such threshold exists?
[1+3+3]
3. a) Draw the schematic diagram of a cyclotron and discuss how it works. Derive an expression for the maximum energy obtained by the charge particle under acceleration. What kind of problem arises when the velocity of the particle becomes relativistic? How can it be tackled?
[2+4+3+1+2]
b) A cyclotron having dees of radius 0.4 m is adjusted for accelerating hydrogen nuclei. The frequency of r.f. oscillator is 3×10^7 Hz. Find the energy of the particles in the issuing beam. Mass of proton = 1.67×10^{-27} kg.
[3]

[Turn over

4. a) What do you mean by elementary particles? How they are classified? Which among them are the constituents of matter?

b) What are leptons? Mention names of all members of lepton family with generations. Are all of them stable? Explain with example.

[1+3+2]+[1+6+2]

5. a) What are strange particles?

b) What are the basic interactions in nature? Which basic interaction allows flavor changing of quarks? Explain with one example.

c) What are gluons? What are the basic differences between a gluon and a photon?

d) What do you mean by primary and secondary cosmic rays and what are their constituents? What is latitude effect of cosmic rays and how can you explain it?

[2+4+2+(2+2+3)]

6. a) What is isospin quantum number? How it was assigned to particles? - Explain with example.

b) Draw pseudo scalar meson octet in weight diagram.

c) Write down the quark contents of any six members of the above mentioned meson octet with proper justification.

[4+5+6]

7. a) Draw the Number of ion-pairs collected vs Applied voltage graph for gas filled detectors and name each region. Describe working of any one region.

b) What are Townsend avalanche and gas multiplication factor?

c) What is scintillation counter? Discuss its working.

[(4+3)+3+5]