Sr. No. 321603

DECEMBER 2023, Supplementary Examinations

B.Sc. (H) Physics Semester-VI

Nuclear and Particle Physics (DECP-601)

Time: 3 Hours

Max. Marks:75

Instructions:

1. *It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2. *Answer any four questions from Part -B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Use of non-programmable simple calculator is allowed.*

PART -A

Q1 (a) The radius of Ge is found to be twice the radius of $^{9}_{4}Be$. Determine the number of nucleons in Ge. (1.5)

(b) State the assumption of Fermi gas model. (1.5)

(c) What are the assumptions of the liquid drop model? (1.5)

(d) What is meant by saturation of nuclear forces. (1.5)

(e) What is the difference between spontaneous fission and induced fission? (1.5)

(f) Write down the nuclear magic numbers. What is their significance? (1.5)

(g) Explain magnetic moment and electric quadruple moment of a nucleus. (1.5)

(h) In what respects is an antiparticle similar to and dissimilar from a particle? (1.5)

(i) State two differences between internal conversion and photoelectric effect. (1.5)

(j) Why is $^{14}_{6}C$ radioactive while $^{12}_{6}C$ is not? (1.5)

PART -B

Q2 (a) Write the semi empirical mass formula. How do various terms arise in the semi-empirical mass formula? Discuss their significance. (10)

(b) Distinguishn between compound nucleus reaction and direct reaction with example. (5)

Q3 (a) Sketch the Baryon Octet based on the quark model and assign the required quantum number. (8)

(b) What are the evidences of shell structure of a nucleus? What are the assumptions of the shell model of a nucleus? (7)

Q4 (a) Find the threshold wavelength of gamma rays needed to produce a proton anti-proton pair. (5)
$M(^{1}_{1}H)$ =1.007825u; $M(^{2}_{1}H)$ =2.014102u; $M(^{4}_{2}He)$=4.002603u;
Mass of a neutron = 1.008665u

(b) Show that the nuclear density is the same for all the nuclei. (5)

(c) Write the quark contents of the following elementary particles: (5)
n, p, η^{o}, K^{+}, Σ^{o}

Q5 (a) Explain which of the following reactions are allowed or forbidden under the conservation of strangeness, conservation of baryon number, conservation of charge, conservation of isospin, conservation of z component of Isospin, conservation of Lepton number. Also state the kind of interaction followed. Else state the conservation laws that are violated. (10)

(i) $\Omega^- \rightarrow \Xi^0 + K^-$

(ii) $p + n \rightarrow \Xi^- + K^+ + \Sigma^+$

(iii) $e^- + e^+ \rightarrow \mu^- + \mu^+$

(b) How do the gamma rays and neutrons interact with matter? Distinguish between the Bremsstrahlung radiation and Cerenkov radiation.? (5)

Q6 (a) What is the working principle of cyclotron? What are its limitations? How can they be overcome in a synchro-cyclotron? (10)

(b) A cyclotron with the applied potential of 20KeV across the dees of radius of 28 cm is subjected to a transverse magnetic field of 1.1 Tesla. Calculate the energy to which a proton can be accelerated. (5)

Q7 (a) Distinguish between different fundamental interaction on the basis of their strength, range and reaction rate. Name the exchange particle involved in each case. (8)

(b) What conservation laws were apparently being violated in the observed continuous beta spectrum? How did it help Pauli in predicting the nature of a new particle? (7)

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