

- (b) What is Cerenkov radiation and how is it generated? What are the conditions for the generation of Cerenkov radiation? (10,5)
6. (a) Give the quark structure of a neutron. Based upon this quark structure, give the charge number, spin, baryon number and strangeness of a neutron.
- (b) Check whether the strangeness and baryon number of the following decay is conserved or not :
- (i) $p + p \rightarrow p + \Lambda^0 + \Sigma^+$
- (ii) $\pi^- + p \rightarrow \Sigma^0 + \nu$
- (c) What are strange particles? Find the charge number, baryon number and strangeness of particle described by the quark structure (sss). Identify the particle. (6,5,4)
7. (a) Sketch the Baryon Octet based on the Quark model with assigned quantum numbers.
- (b) Mention any two differences between leptons and hadrons. Give two examples of each.
- (c) What do you understand by colour quantum number? How does Δ^{++} give the clue for necessity of colour quantum number? (6,4,5)

(100)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5898

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Unique Paper Code : 2224002010

Name of the Paper : Nuclear and Particle Physics

Name of the Course : **B.Sc. Physical Science-
(Physics)_NEP: UGCF-2022**

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

- Write your Roll No. on the top immediately on receipt of this question paper.
 - Attempt **Six** questions in total.
 - Question **1** is compulsory.
 - Calculator is **NOT** allowed.
- Attempt all **five** questions out of the following :
(3×5)
 - Determine the radius of ^{208}Pb .
 - What are magic numbers? What is their significance?

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- (c) What is Geiger-Nuttall law and represent it graphically.
- (d) What is a pickup/stripping reaction? Give one example of pickup reaction.
- (e) Give any three reasons for the non-existence of electrons in the nucleus.
2. (a) Define Binding Energy? Represent graphically the variation of average binding energy per nucleon with the mass number A. Also discuss the regions resulting from fusion and fission processes from the graph.
- (b) The binding energy of the neon isotope $^{20}_{10}\text{Ne}$ is 160.647 MeV. Find its atomic mass.
- (c) The radius and mass of oxygen nuclide is found to be 3 fm and 2.7×10^{-26} kg respectively. Compute its density. (8,5,2)
3. (a) What is a neutrino? Explain how neutrino hypothesis explains the process of β decay?
- (b) What are the assumptions of Gamow's theory of alpha decay. Calculate the collision frequency of an alpha particle that knocks its nuclear wall with a velocity of 2×10^7 m/s.

- (c) The activity of certain nuclide decreases to 30% of its original value in 100 days. Find the half-life of the nuclide and find after how many days the activity will be reduced to 99% of its original value. (5,5,5)
4. (a) Give any three differences of compound nucleus reaction and a direct reaction. Give one example of each.
- (b) Calculate the Q value of the reaction $p + {}^4_2\text{He} \rightarrow {}^2_1\text{H} + {}^3_2\text{He}$. Find out whether the reaction is exoergic or endoergic. Also find the Threshold Energy, E_{th} for this reaction. Given that $m({}^2_1\text{H}) = 2.014102$ u; mass of proton (p) = 1.007276 u; $m({}^3_2\text{He}) = 3.016029$ u; $M({}^4_2\text{He}) = 4.002603$ u.
- (c) Determine the distance of closest approach of α -particles to the copper nucleus ($Z=29$) when α -particles of 5 MeV energy are scattered by a thin sheet of copper. (5,5,5)
5. (a) How does a heavy charged particle interact with matter? Derive an expression for the stopping power for a heavy charged particle in a medium, without finding the value of b (impact parameter).