a wire of 25 pm diameter at +700 V in the centre. What is the electric field at the wire?

(c) A cyclotron with Dee's of diameter 1.8 m has a magnetic field of 0.8 T. Calculate the energy to which the doubly ionised helium ion He^{++} can be accelerated. Also calculate the number of revolutions the particle makes in attaining this energy. [Mass of $He^{++} = 6.68 \times 10^{-27}$kg]

(5+5+5)

7. (a) Give the quark structure of a neutron and based upon quark structure give the correct charge number, spin, baryon number and strangeness.

(b) Check whether strangeness and baryon number of the following decay is conserved or not?

(i) $p + p \rightarrow p + \Lambda^0 + \Sigma^+$

(ii) $\pi^- + p \rightarrow \Sigma^\circ + \nu$

(c) What are strange particles? Find the charge number, baryon number and strangeness of a particle described by the quark structure (sss).Identify the particle. (6+4+5)

PHYSICAL CONSTANTS

$m_H = 1.007825$ u, $m_n = 1.008665$ u

$m_e = 0.00055$ u, $m(^4_2He) = 4.002603$ u

$1\ u = 1.66 \times 10^{-27}$ kg, $R_0 = 1.2$ fin

$e_0 = 8.85 \times 10^{-12} C^2/Nm^2$, $h = 6.6 \times 10^{-34}$ Js

$c = 3 \times 10^8$ m/s, $1\ eV = 1.6 \times 10^{-19}$J

6 Dec

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1240 **C**

Unique Paper Code : 32227504

Name of the Paper : Nuclear and Particle Physics

Name of the Course : **B.Sc. (Hons.) Physics-CBCS**

Semester : V

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all. Question No. **1** is compulsory.
3. **All** questions carry equal marks.
4. Use of Scientific Calculator is allowed.
5. Values of required constants have been given at the end.

1. Answer any **five** : (3×5=15)

(a) Determine the radius of ^{208}Pb.

(b) What are magic numbers? What is their significance?

(c) Give three main differences between direct and compound-nucleus reactions.

(d) What is stripping reaction? Give one example of stripping reaction.

(e) Differentiate between pair production and internal pair conversion.

(f) Why is G.M. counter not suitable for energy and charge spectroscopy applications?

(g) What would be the energy that is required to annihilate proton and antiproton?

(h) Why photoelectric effect is not possible with free electrons?

2. (a) Plot the binding energy per nucleon vs mass number. Explain with its help the release of energy in the processes of fission and fusion.

(b) Calculate de Broglie wavelength for an electron having energy 15 MeV. Show that electron does not exist inside the nucleus.

(c) Find the energy required to knock out nucleons from the He nucleus. (7+3+5)

3. (a) Explain liquid drop model. Obtain semi-empirical mass formula. Give any two achievements of the model.

(b) Calculate the coulomb energy of $^{238}_{92}U$.

(c) State the assumptions of Fermi gas model of nucleus. (8+5+2)

4. (a) What conservation laws were apparently violated due to typical continuous energy distribution of the β-decay electrons? How did Pauli proposal of new particle overcome on these violations?

(b) The total energy liberated in the α-decay of $^{226}_{88}Ra$ is 4.87 MeV, (i) Identify the daughter nucleus, (ii) calculate the kinetic energy of α-particle and (iii) calculate the recoil energy of the nucleus.

(c) Explain secular and transient equilibrium. (7+4+4)

5. (a) How does a heavy charged particle interact with matter? Derive an expression for the energy loss per unit path length travelled by the heavy charged particle.

(b) Define the Q-value for a nuclear reaction. What is its significance. If the Q-value for the reaction $^{14}Na(\alpha,p)^{17}O$ is –1.20 MeV, find the minimum kinetic energy in the lab system required by an α particle to cause this reaction. (10+5)

6. (a) Explain the procedure by which high potential of the order of MV is generated in a Tandem accelerator. Explain the purpose of using SF_6 gas in Tandem accelerator tank.

(b) Define quenching in GM counters. A GM counter consists of a 50 mm diameter grounded tube with