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G – 5248

Reg. No. :

Name :

Fourth Semester M.Sc. Degree Examination, September 2019

Physics

PH 242: NUCLEAR AND PARTICLE PHYSICS

(2014 admission onwards)

Time : 3 Hours

Max. Marks : 75

PART – A

Answer **any five** questions. **Each** question carries **3** marks.

- I (a) Do the neutron elastic scattering cross section depend up on energy for very low energy neutron.
- (b) Illustrate with example the conservation laws obeyed in a nuclear reaction.
- (c) What are Nordheim rules and how they are used to predict the ground state angular momentum of odd- odd nuclei.
- (d) There is no known meson of electric charge of two, can you give a simple explanation of this.
- (e) What are Schmidt lines?
- (f) Discuss various selection rules in beta decay.
- (g) Explain the concept of multipole radiations related to gamma decay.
- (h) What are coloured quarks?

(5 × 3 = 15 Marks)

P.T.O.



PART – B

Answer **all** questions. Each question carries **15** marks.

- II (a) Describe in detail the partial wave analysis of n-p scattering at low energies and derive expression for the scattering cross section.

OR

- (b) Give the theory of ground state of deuteron using square well potential for inter nucleon force. Why do the deuteron moments deviate from their expected value?

- III (a) Give Gamow's theory of alpha decay and derive an expression for half-life.

OR

- (b) Derive and explain Breit Wigner resonance formula for nuclear reaction.

- IV (a) Write down the Gell-Mann-Nishijima relationship, which gives the charge of mesons and baryons in terms of certain quantum numbers. Explain each term and briefly explain their usefulness in discussing particle reactions. Give the values of these quantum numbers of proton, antiproton, neutron, antineutron.

OR

- (b) Explain the eight-fold way and SU(3) model for strong interaction. Discuss CPT invariance.

(3 × 15 = 45 Marks)



PART – C

Answer **any three** questions. Each question carries **5** marks.

- V
1. Calculate the mass in grams of one Curie of radioactive element Pb^{214} whose half life is 26.8 minutes. Give 1 curie = 3.7×10^{10} disintegration/second.
 2. Predict the ground state spin and parity of the following nuclei using the shell model ${}^3_2\text{He}$, ${}^{17}_8\text{O}$, ${}^{34}_{19}\text{K}$ and ${}^{41}_{20}\text{Ca}$
 3. Using the spherical harmonic-oscillator shell model, describe the expected configurations for the ground states of the light stable nuclei with $A \leq 4$, Specifying also their total L, S and J and parity.
 4. Explain why each of the following particles cannot exist according to the quark model (a) A baryon of spin 1 (b) An antibaryon of electric charge +2 (c) A meson with charge +1 and strangeness $S=1$.
 5. The nucleus ${}^{12}_7\text{N}$ decays to ${}^{12}_6\text{C}$ with Q value 16.38 MeV. Calculate the maximum recoil energy of the daughter nucleus.
 6. Since ${}^{27}_{14}\text{Si}$ and ${}^{27}_{13}\text{Al}$ are mirror nuclei, their ground states are identical except for charge. If their mass difference is 6 MeV, estimate their radius (neglecting the proton-neutron mass difference).

(3 × 5 = 15 Marks)

