

23P307

(Pages: 2)

Name:

Reg.No:

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2024

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY3 C10 - NUCLEAR AND PARTICLE PHYSICS

(Physics)

(2019 Admission onwards)

Time : 3 Hours

Maximum : 30 Weightage

Section A

Answer *all* questions. Each question carries 1 weightage.

1. What is tensor force and how it become related to nuclear force?
2. How did fermi theory of beta decay reach to a conclusion that neutrino is massless?
3. Outline the characteristics of multipole radiation.
4. Explain coulomb energy and asymmetry energy terms in semi-empirical mass formula.
5. Briefly explain the working of a photomultiplier tube with a neat diagram.
6. Briefly explain the working of a single channel analyzer.
7. Explain CPT theorem.
8. Discuss the spin $\frac{1}{2}$ baryon, and meson octets based on eightfold way model.

(8 × 1 = 8 Weightage)

Section B

Answer any *two* questions. Each question carries 5 weightage.

9. Derive partial wave analysis of nucleon-nucleon scattering.
10. Explain magnetic moment and electric quadrupole moment according to shell model and Explain how shell model explains magic numbers using S-L interaction?
11. Explain GM counters and scintillation detectors in detail.
12. Discuss the classification of elementary particles based on spin and interaction. List the quantum number conservations in particle interactions.

(2 × 5 = 10 Weightage)

Section C

Answer any *four* questions. Each question carries 3 weightage.

13. Compute the total B.E and B.E/nucleon for a) ${}^7\text{Li}$ b) ${}^{20}\text{Ne}$ c) ${}^{56}\text{Fe}$ d) ${}^{235}\text{U}$
14. In a radioactive chain starting with ${}^{242}_{94}\text{Pu}$ and ending with ${}^{206}_{82}\text{Pb}$, calculate the total number of alpha and beta particles emitted.

15. a) An element X decays, first by positron emission and then two alpha particles are emitted in successive radioactive decay. If the product nucleus has a mass number 229 and atomic number 89, find out the mass number and atomic number of element X.
 b) A nucleus m_nX emits one alpha particle and two beta particles. Write down the resulting nucleus.
16. The first excited state of the rotational spectrum of the nucleus ${}^{238}_{92}\text{U}$ has an energy 45 keV above the ground state. Calculate the energy of the second excited state in keV.
17. Estimate the energy released when two deuteron nuclei fuse to form He nucleus. Given that binding energy per nucleon of ${}^2_1\text{H} = 1.1$ MeV and that of ${}^4_2\text{He} = 7$ MeV.
18. a) Find the value of third component of isospin of Ξ^- in the following strong interaction:

$$\pi^+ + n \rightarrow \Xi^- + K^+ + K^-$$

 b) Identify the type of the following interaction from conservation law: $\Sigma^0 \rightarrow \Lambda^0 + \gamma$ (life time $< 10^{-14}$)
19. Write the quark model of following particles. a) Σ^+ b) K^+ c) proton

(4 × 3 = 12 Weightage)
