22P307 (Pages: 2) Name: .....

Reg.No: .....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2023

(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. Briefly enumerate properties of nuclear force.
2. Derive an expression for the kinetic energy of the alpha particle.
3. Briefly explain Pauli's neutrino hypothesis.
4. Explain how reaction cross-section and reaction rate vary in nuclear fusion.
5. Classify the principles of nuclear radiation detection.
6. Distinguish between a single channel analyser and multichannel analysers.
7. Give a detailed explanation for families of particles.
8. Write a short note on conservation of parity.

(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. Give the evidences of the shell structure of the nucleus. Explain the shell model of the nucleus starting from main assumptions.
11. Explain semiconductor detectors and surface barrier detectors in detail.
12. Describe the eight fold way and show how the octet and decuplet of particles can be formed. Explain quark theory as evolved from Eight fold way model.

(2 × 5 = 10 Weightage)

Section C

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

13. Compute the total BE and BE per nucleon for : a) Ne^{20} b)Fe^{56} c)U^{235}

14. Classify the following beta decays as (allowed, firstforbidden, etc) and type (fermi, Gamow-Teller) transitions.
    a) $^{3}H(1/2+)$ à $^{3}He(1/2+)$
    b) $^{14}O(0+)$ à $^{14}N(0+)$
    c) $^{47}Sc(7/2-)$ à $^{47}Ti(3/2-)$
    d) $^{36}Cl(2+)$à$^{36}S(0+)$
    e) $^{153}Eu(3+)$ à $^{152}Sm(2+)$
    f) $^{50}V(6+)$à$^{50}Ti(2+)$

15. Find the multipolarities of radiations emitted in the following gamma transitions.
    a) 3/2+ à 1/2+
    b) 2+ à0+
    c) 9/2-à1/2+
    d) 6+ à1-

16. The first excited state of the rotational spectrum of the nucleus $^{238}_{92}U$ has an energy 45 keV above the ground state. Calculate the energy of the second excited state in keV.

17. Calculate the energy released by the fission of a gram of U^{235} . The energy released per fission is 200 MeV.

18. Consider the four processes.
    a) $p^{+} \rightarrow n + e^{+} + \nu_e$
    b) $\Lambda^{0} \rightarrow p^{+} + e^{+} + \nu_e$
    c) $\pi^{+} \rightarrow e^{+} + \nu_e$
    d) $\pi^{0} \rightarrow \gamma + \gamma$

19. Analyze the following reactions according to their quark content. In each case state whether the reaction is possible or not.
    a) $\Omega^{-} \rightarrow \lambda^{o} + K^{-} + p$
    b) $\Xi^{-} \rightarrow \lambda^{o} + \pi^{-}$
    c) $K^{+} \rightarrow \pi^{o} + \pi^{-}$

(4 × 3 = 12 Weightage)

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