21P307 (Pages: 2) Name: ....

Reg.No: ....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2022

(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. How can you say that nuclear force is spin dependant?
2. Derive an expression for the kinetic energy of the alpha particle?
3. Briefly explain parity violation in beta decay.
4. What are magic numbers? How will you account it with help of shell model?
5. Briefly explain the working principle of a GM counter.
6. Describe the working principle of single channel and multichannel analyzers.
7. Explain the differences between four basic forces.
8. Explain CPT theorem.

(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. Write a note on the collective model of the nucleus.
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 ***four*** questions. Each question carries 3 weightage.

13. Evaluate neutron separation energies of ^{7}Li, ^{91}Zr, ^{236}U.
14. 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 $^{m}_{n}X$ emits one alpha particle and two beta particles. Write down the resulting nucleus.

15. What are the expected types of gamma ray transitions between the following gamma types off odd A nuclei:

    $F_{5/2\,+}$à $P_{3/2-}$

    $H_{11/2\,-}$à$D_{5/2+}$

    $G_{9/2-}$ à$P_{1/2+}$

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

17. Calculate the Q value of the reaction:

    $H_1^3 + H_1^2 \rightarrow H_2^4 + n_0^1$

    Masses are 3.01699824u, 2.01473614u, 4.00387274u and 1.00899324u respectively.

18. Which of the following reactions are allowed ?

    a) $\pi^- + p \rightarrow \Lambda^o + K^o$

    b) $\pi^- + p \rightarrow K^+ + K^-$

    c) $\Sigma^- + p \rightarrow \Lambda^o + n$

19. Analyse the following reactions according to their quark content

    a) $K^- + p \rightarrow \Omega^- + K^+ + K^o$

    b) $p + p \rightarrow \pi^+ + \Lambda^o + K^o$

    c) $K^- + p \rightarrow \Xi^- + K^+$

    d) $\pi^- + n \rightarrow \Delta^- + \pi^o$

(4 × 3 = 12 Weightage)

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