

20P307

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Name:

Reg. No:

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2021

(CBCSS-PG)

(Regular/Supplementary/Improvement)

CC19P PHY3 C10 - NUCLEAR AND PARTICLE PHYSICS

(Physics)

(2019 Admission onwards)

Time: Three Hours

Maximum: 30 Weightage

Section A

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

1. Explain why the magnetic moment of deuteron is not equal to the sum of magnetic moments of neutron and proton?
2. Derive the Q value equations in β^- and β^+ decays.
3. 'Nuclear fission does not occur spontaneously.' Why?
4. What are the conditions of temperature and density under which nuclear fusion can occur?
5. Discuss the behaviour of a gas filled counter at various voltages.
6. Explain the working principle of scintillation detectors.
7. Discuss the spin $\frac{1}{2}$ baryon and meson octets based on eight fold way model.
8. Briefly explain the experimental evidences for quark confinement.

(8 × 1 = 8 Weightage)

Section B

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

9. Derive the equation for the cross section of s-wave n-p scattering using partial wave analysis. Discuss the difference between positive and negative scattering lengths.
10. Explain the classical and quantum theories of γ - transitions. What are the relevant selection rules involved in γ -decay?
11. What are the experimental evidences for the existence of magic numbers? Give a brief account of the extreme single particle shell model which predicts the magic numbers.
12. Describe the symmetries and conservation laws in particle physics with suitable examples.

(2 × 5 = 10 Weightage)

Section C

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

13. Find the energy needed to remove a neutron from ${}_{36}^{81}\text{Kr}$, ${}_{36}^{82}\text{Kr}$ and ${}_{36}^{83}\text{Kr}$. Why is the value of energy for ${}_{36}^{83}\text{Kr}$ is different from others?
14. A given nucleus decays first by beta decay from its 2^+ ground state to the 2^- excited state of the daughter nucleus. Using the appropriate selection rules, identify the type of beta transition (Fermi or G-T).
15. A permanently deformed even-even nucleus with $J^\pi = 2^+$ has rotational energy 93 KeV. Find the energy of next two excited states.
16. Find the magnetic dipole and electric quadrupole moments of ${}_{12}^{25}\text{Mg}$ and ${}_{19}^{39}\text{K}$.
17. A particles of energy 14 MeV passing through an ionization chamber completely lose their energy. Find the number of ion pairs produced and output pulse height if 20 pF capacitor is employed in the system.
18. State whether the reactions are allowed or not, based on the basic conservation laws.
 - (a) $K^- \rightarrow \mu^0 + \nu_\mu$
 - (b) $K^- \rightarrow \pi^0 + \pi^+$
 - (c) $K^- \rightarrow \pi^0 + e^+ + \nu_e$
 - (d) $K^- \rightarrow \pi^0 + e^+$
19. Analyse the following reactions according to their quark content
 - (a) $K^- + p \rightarrow \Omega^- + K^+ + K^0$
 - (b) $p + p \rightarrow p + \pi^+ + \Lambda^0 + K^0$
 - (c) $K^- + p \rightarrow \Xi^- + K^+$
 - (d) $\pi^- + n \rightarrow \Delta^- + \pi^0$

(4 × 3 = 12 Weightage)
