

(6 Pages)

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M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2021.

Fourth Semester

Physics — Core

NUCLEAR AND PARTICLE PHYSICS

(For those who joined in July 2017 onwards)

Time : Three hours

Maximum : 75 marks

PART A — ($10 \times 1 = 10$ marks)

Answer ALL questions.

Choose the correct answer :

1. The interaction that describes the forces among nucleons that hold nuclei together is
 - (a) the strong nuclear (hadronic) interaction
 - (b) the electromagnetic interaction
 - (c) the weak nuclear interaction
 - (d) the gravitational interaction

2. Why are nuclear energy levels more complex than electron energy levels?
- (a) Nuclear energy levels depend only on attractive forces
 - (b) Nuclear energy levels depend on attractive and repulsive forces
 - (c) Nuclear energy levels are an order of one hundred times as great as electron energy levels
 - (d) Electron energy levels depend on the interaction between neutrons and electrons
3. A beta β^- particle is also known as
- (a) an electron
 - (b) a positron
 - (c) a helium nucleus
 - (d) a photon
4. When an alpha particle is emitted from an unstable nucleus, the atomic mass number of the nucleus
- (a) increases by 2
 - (b) decreases by 2
 - (c) increases by 4
 - (d) decreases by 4

5. The asymmetry term in semi-empirical mass formula is due to
- (a) non-spherical shape of the nucleus
 - (b) non-zero spin of the nucleus
 - (c) unequal number of protons and neutrons in the nucleus
 - (d) odd number of protons inside the nucleus
6. According to the shell model of the nucleus
- (a) magic number exist
 - (b) nucleons interact with their nearest neighbours only
 - (c) nucleons in a nucleus interact with a general force field
 - (d) Large electronic quadrupole moment exists for certain nuclei
7. The reaction ${}_3\text{Li}^7 + {}_1\text{H}^1 \rightarrow ({}_3\text{Li}^7)^* + {}_1\text{H}^1$ is example for
- (a) Photo disintegration
 - (b) Radioactive capture
 - (c) Elastic scattering
 - (d) Inelastic scattering

8. When the nuclear reaction takes place, which of the following is true about the reaction?
- (a) The energy, charge and mass are conserved
 - (b) The energy, charge and nucleons are conserved
 - (c) The mass alone is conserved
 - (d) The number of nucleons is conserved
9. A massless boson, is called as
- (a) Mesons
 - (b) Graviton
 - (c) Kaons
 - (d) Hyperons
10. According to the lepton conservation number _____ reaction is allowed.
- (a) $\mu^+ \rightarrow e + + \nu$
 - (b) $\mu^+ \rightarrow e + + \nu + \nu$
 - (c) $K^0 \rightarrow \pi^+ + \pi^-$
 - (d) $K^0 \rightarrow \pi^+ + \pi^- + \pi^0$

PART B — ($5 \times 5 = 25$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Describe ground states of deuteron.

Or

- (b) Write short notes on exchange forces.

12. (a) Discuss the Gamow's theory of alpha decay.

Or

(b) Explain about violation in parity conversion.

13. (a) Describe about stability of nucleus.

Or

(b) Discuss briefly the collective model.

14. (a) Classify the types of nuclear reaction.

Or

(b) Derive the four factor equation.

15. (a) Classify the elementary particles.

Or

(b) Explain CPT theorem.

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Explain n-p scattering at low energies.

Or

(b) Describe in detail about shape independent effective range theory.

17. (a) Explain in detail about Fermi and Gamow-selection rules.

Or

- (b) Discuss in detail about nuclear isomerism.

18. (a) Describe in detail about liquid drop model with weizsackers mass formula.

Or

- (b) Write brief notes on shell model.

19. (a) Derive the Q-equation and its solution.

Or

- (b) Derive Breit Wigner dispersion formula.

20. (a) Explain the fundamental interactions of elementary particles.

Or

- (b) Write brief note on SU(3) multiplet.
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