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Reg. No. : .....

Code No. : 5867 **Sub. Code : PPHM 43**

M.Sc. (CBCS) DEGREE EXAMINATION,
APRIL 2020.

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 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The nuclear forces have at least in part, an exchange character and they are like
   (a) molecular forces (b) atomic forces
   (c) ionic forces (d) vander waals forces

2. The meson theory of nuclear forces was given by
   (a) Heisenberg (b) Yukawa
   (c) Wigner (d) Bartletts

3. The spin of α-particles is

(a) 1/2 (b) 0

(c) 1 (d) 2

4. β-decay is not the disintegration of free neutrons but is the overall property of

(a) neutron (b) proton

(c) atom (d) nucleus

5. The magic numbers are

(a) 2, 8, 20, 28, 50, 82, 126

(b) 2, 4, 8, 18, 52

(c) 20, 40, 80, 126

(d) 3, 6, 9, 12, 15

6. The collective model was developed by

(a) De Broglie (b) Bohr and Moltelson

(c) Nilsson (d) Fermi

7. The unit of reaction cross-section is

(a) barn (b) fermi

(c) rutherford (d) m^{-1}

8. The compound nucleus theory was given by

(a) Rutherford (b) Nelsson

(c) Curie (d) Bohr

9. In elementary particle the mirror symmetry is known as

(a) isomerism

(b) strangeness

(c) parity

(d) charge independence

10. Nuclear particles are bound in nucleus by

(a) gravitational force

(b) mesonic force

(c) electrostatic force

(d) electromagnetic forces

PART B — (5 × 5 = 25 marks)

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

Each answer should not exceed 250 words.

11. (a) Give a brief description of exchange forces. Explain their significance for nuclear structure.

Or

(b) Derive an expression for electric quadrupole moment of a nucleus.

12. (a) What do you mean by nuclear isomers? Give examples with nuclear energy diagram.

Or

(b) What is internal conversion? Give its theory.

13. (a) Discuss collective model of nucleus. How does it give results concerning the low lying excited states of nuclei?

Or

(b) Describe liquid drop model of nucleus. Point out its usefulness and limitations in understanding the nuclear phenomena.

14. (a) Explain Q-value of a reaction. How is it related to threshold energy of a particle?

Or

(b) Explain four-factor formula regarding nuclear fission in an assembly.

15. (a) Discuss the CPT theorem.

Or

(b) What do you understand by the classification of elementary particles?

PART C — ($5 \times 8 = 40$ marks)

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

Each answer should not exceed 600 words.

16. (a) Give a simple theory of deuteron obtain and plot the wave function for the deuteron ground state taken as an S-state.

Or

(b) Give the theory of n-p scattering at low energy.

17. (a) Give the Fermi theory of $\beta-$ decay. Explain the transitions in $\beta-$ emission with selection rules.

Or

(b) Discuss Gamow's theory of α - decay. How far does this explain the Geiger-Nuttall law?

18. (a) What are magic numbers? How magic numbers and energy levels were predicted by single particle shell model? Discuss the role of spin-orbit interaction.

Or

(b) Give an account of Bohr-Wheeler theory of nuclear fission. Discuss the various factors affecting the critical size of a reactor.

19. (a) Derive Breit Wigner formula for nuclear reactions.

Or

(b) Describe the compound nucleus theory of nuclear reactions.

20. (a) What are quarks? Give quantum number associated with each quark. How are these quarks combine to form baryons and mesons?

Or

(b) Discuss in detail Gell-Mann and Neeman classification of elementary particles.

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