

Reg. No

Name

23P4016

M. Sc. DEGREE END SEMESTER EXAMINATION : MARCH 2023

SEMESTER 4 : PHYSICS

COURSE : 21P4PHYT14 : NUCLEAR AND PARTICLE PHYSICS

(For Regular - 2021 Admission)

Duration : Three Hours

Max. Weights: 30

PART A

Answer any 8 questions

Weight: 1

1. What are Higg's bosons? Describe briefly. (U, CO 5)
2. What is LHC? Briefly describe its application. (U, CO 5)
3. Plot a labeled schematic showing kinematics of nuclear reaction. (U, CO 3)
4. Distinguish between disintegration and photodisintegration. (An, CO 3)
5. Discuss the meson theory of nuclear forces. Mention the limitations of the theory. (An, CO 1)
6. What is internal conversion? How does it take place? (A, CO 2)
7. What are quarks? Describe the quantum numbers associated with them. (U, CO 4)
8. What are isomers? Give examples (An, CO 2)
9. Describe briefly standard model? (U, CO 4)
10. Can you name a particle which can interact via all the four basic intreraction. Explain your answer. (R)

(1 x 8 = 8)

PART B

Answer any 6 questions

Weights: 2

11. Discuss the variation (with graph) in Coloumb scattering as the energy of the incident alpha particle increases. (A, CO 3)
12. Discuss with supporting graph or figures the concept of mass resolution in RBS. (A, CO 5)
13. Plot a graph showing the number of scattered particles from gold foil vs KE of the incident alpha particles (Coloumb scattering). Discuss the slope of the graph. (An, CO 3)
14. Establish the relation $Z \sim \frac{A}{2}$ for light nuclei using the semi-empirical mass formula. (Cr, CO 2)
15. Write a note on CPT invariance. (Cr)
16. Calculate the spin, parity, magnetic moment and quadrupole moments of ${}^8_0\text{O}^{17}$ and ${}_{16}^{33}\text{S}$ (E, CO 2)
17. The Meson theory of nuclear force assumes the virtual exchange of pions. If a nucleon emits a virtual pion of rest mass $270 m_e$, show that the range of nuclear force is 1.43fm. (An, CO 1)
18. Assuming central potential and using semi-classical picture, calculate magnetic moment of deuteron. Compare theoretical and calculated values and comment. (E, CO 1)

(2 x 6 = 12)

PART C
Answer any 2 questions

Weights: 5

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| 19. | Explain the four types of interactions. Classify roughly the fundamental forces in terms of strength and range by considering the mediating particles. | (U, CO 4) |
| 20. | What is nuclear cross section? Describe the partial wave analysis of reaction cross-section for neutron scattering. | (A, CO 1) |
| 21. | Give the Semi-Empirical Mass formula and describe in detail various terms (classical and quantum descriptions) in it to arrive B/A vs A curve. | (An, CO 2) |
| 22. | Plot an approximate graph showing relative abundance of various elements. Explain the nucleosynthesis of elements with A greater than 56 (beyond iron)? | (A, CO 5) |
| | | (5 x 2 = 10) |

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	Understand the basic properties of the nucleus and the nuclear forces.	U	5, 17, 18, 20	10
CO 2	Understand Major models of the nucleus and the theory behind the nuclear decay process	U	6, 8, 14, 16, 21	11
CO 3	Understand the physics of nuclear reactions	U	3, 4, 11, 13	6
CO 4	Understand the interaction between elementary particles and the conservation	U	7, 9, 19	7
CO 5	Understand Nuclear Astrophysics, nucleosynthesis and basic applications of nuclear physics.	U	1, 2, 12, 22	9

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;