Reg. No ....   Name **24P4016**

M. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2024
SEMESTER 4 - PHYSICS
COURSE : **21P4PHYT14 - NUCLEAR AND PARTICLE PHYSICS**
(For Regular - 2022 Admission and Supplementary - 2021 Admission)

Duration : Three Hours   Max. Weights: 30

PART A
Answer any 8 questions   Weight: 1

1.	State the fundamental assumptions of Fermi's theory of beta decay.	(An, CO 2)
2.	Describe a method used for the measurement of magnetic moment of neutron.	(E, CO 1)
3.	What do you understand by nuclear reaction? Briefly outline various interactions involved in nuclear reactions.	(U, CO 3)
4.	What are colored quarks? Why was it necessary to introduce an additional property designated as color to quarks and anti-quarks?	(A, CO 4)
5.	When electron is not an integral part of a nucleus, how do we justify the emission of electrons from nucleus in β-decay?	(A, CO 2)
6.	What is magnetic moment? Give its unit. How is it related to angular momentum? (semi-classical picture)	(An, CO 1)
7.	What is PET? Explain its applications.	(An)
8.	Define and explain the term nuclear reaction cross section. What is its unit?	(A, CO 3)
9.	What are leptons? Mention the particles that fall into this group.	(A, CO 4)
10.	Define gravitational waves?	(U, CO 5)

(1 x 8 = 8)

PART B
Answer any 6 questions   Weights: 2

11.	Define threshold energy of a nuclear reaction. Give an expression for it.	(A, CO 3)
12.	Assuming that the nuclear force arises from exchange of mesons, estimate the mass of the meson using Heisenberg's uncertainty relation, if the range of the nuclear force is 1.4 fm.	(An, CO 1)
13.	Find the angular momentum and Parity of a nuclear with A = 17 Z=8.	(E)
14.	What is electrical quadrupole moment of a nucleus? What is its role in nuclear physics?	(E, CO 1)
15.	Explain two possible ways of formation of various elements for the first time in the universe.	(A, CO 5)
16.	Explain different quantum numbers associated with elementary particles.	(An, CO 4)
17.	While there is only single mass parabola for odd A nuclei, there will two mass parabolas for even A nuclei. Explain the reason with the help of examples.	(An, CO 2)
18.	What are the different processes of beta decay? Show that the negatron (β- decay) emission occurs if the mass of the parent atom is greater than the daughter atom.	(A, CO 2)

(2 x 6 = 12)

PART C
Answer any 2 questions   **Weights: 5**

19. Explain with a schematic; discuss the principle and applications of Rutherford Backscattering spectroscopy. List four limitations of it.   (An, CO 5)

20. Discuss a quantum treatment (suitable potential with spin-orbit coupling) which establishes the energy levels inside the nucleus (magic numbers of nucleons). Plot a neat energy level diagram along with nucleons filling.   (An, CO 2)

21. Describe the quantum mechanical treatment of Deuteron. And hence show that a mixing of S and D states are essential to account for the magnetic moment of deuteron.   (A, CO 1)

22. Describe the following: i)Quark model   ii) classification of elementary particles iii) different types of interactions and gauge particles.   (U, CO 4)

(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	2, 6, 12, 14, 21	11
CO 2	Understand Major models of the nucleus and the theory behind the nuclear decay process	U	1, 5, 17, 18, 20	11
CO 3	Understand the physics of nuclear reactions	U	3, 8, 11	4
CO 4	Understand the interaction between elementary particles and the conservation	U	4, 9, 16, 22	9
CO 5	Understand Nuclear Astrophysics, nucleosynthesis and basic applications of nuclear physics.	U	10, 15, 19	8

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