Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2024

Course: Nuclear and Particle Physics **Semester: VI**

Program: Int (BSc + MSc) **Time : 03 hrs.**

Course Code: PHYS3035 **Max. Marks: 100**

Instructions: All questions are compulsory and question no 9 and 11 have internal choices

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Briefly explain the mirror nuclei method for determining nuclear radius.	**4**	**CO1**
Q.2	The contribution of surface energy per nucleon to the binding energy formula in liquid drop model is denoted by E_s, determine the ratio of the surface energy per nucleon for $^{27}_{13}Al$ to $^{64}_{30}Zn$,	**4**	**CO1**
Q.3	Classify the different elementary particles based on their spins.	**4**	**CO4**
Q.4	List the similarities of nucleus with a liquid drop.	**4**	**CO2**
Q.5	Calculate the time required for 10% of a pure sample of $^{232}_{90}Th$ to disintegrate. $T_{1/2}$ = 1.4 x 10^{10} years.	**4**	**CO2**
	SECTION B **(4Qx10M= 40 Marks)**		
Q.6	Binding Energy of a light nuclei (Z, A) in MeV is given by the approximate formula. $$B(A,Z) \cong 16A - 20\,A^{\frac{2}{3}} - \frac{3}{4}\,Z^2\,A^{-\frac{1}{3}} + 30\,\frac{(N-Z)^2}{A}$$ N = A- Z is the neutron number, Determine the value of Z for most stable isobar for a given A. [Hint $\frac{\partial B}{\partial Z} = 0$]	**10**	**CO2**
Q.7	Explain briefly the tunnel theory of alpha decay	**10**	**CO2**
Q.8	Find the spin and Parity of the following nuclei based on Shell model. $^{3}_{2}He$, $^{20}_{10}Ne$, $^{27}_{13}Al$, $^{41}_{21}Sc$	**10**	**CO1**
Q.9	Differentiate between the Direct and Compound nuclear reaction mechanism with examples. OR	**10**	**CO1**

	Define attenuation and hence obtain expression for mass attenuation coefficient of gamma radiations.		**CO1**
SECTION-C (2Qx20M=40 Marks)			
Q.10	a) Describe the phenomena of Compton scattering. Obtain an expression for Compton shift. b) Explain the phenomena of pair annihilation.	**15** **05**	**CO3**
Q.11	Obtain an expression for threshold value for a nuclear reaction to occur. Assume the reaction to be of the type a + A → b + B. OR a) Discuss the different mechanisms by which charge particles interact with matter. b) Determine the minimum energy that a photon should have for it to split an alpha particle into a tritium and a proton. (The masses of $^{4}_{2}He$, $^{3}_{1}H$ and $^{1}_{1}H$ are 4.0026 amu, 3.0161 amu and 1.0073 amu respectively and 1 amu ≈ 938 MeV.	**20** **10** **10**	**CO2** **CO3**