Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, December 2021

Course: Nuclear and Particle Physics **Semester: V**
Program: B.Sc. Physics (Hons)

Time 03 hrs.

Course Code: PHYS 3012D **Max. Marks: 100**

SECTION A

1. **Each Question will carry 4 Marks**
2. **Scan and Upload**

S. No.	**Question**	**CO**
Q 1	Mention the different methods used to determine the nuclear radius. Explain why nuclear density is constant.	**CO1**
Q2	If the mass of a Ca-40 atom is 39.9626 amu, calculate its binding energy.	**CO1**
Q3	a) According to the shell model, find the spin and parity of $^{63}_{29}Cu$. (2) b) State the successes of the Fermi- Gas model. (2)	**CO2**
Q4	Based on the law of conservation of baryon number, which of the following reactions can occur? (i) $\pi^- + p \rightarrow \pi^0 + n + \pi^- + \pi^+$ (ii) $\pi^- + p \rightarrow \Lambda^0 + K^0$	**CO3**
Q5	The possible γ transitions for the following pair of nuclear states will be i) $3^- \rightarrow 2^+$ ii) $(1/2)^- \rightarrow (1/2)^+$	**CO3**

SECTION B

1. **Each question will carry 10 marks**
2. **Scan and Upload**

Q 6	Estimate the thickness of lead (density 11.3g cm^{-3}) required to absorb 90% of gamma rays of energy 1MeV. The absorption cross-section for gammas of 1MeV in lead (A = 207) is 20 barns/atom	**CO4**
Q 7	Explain the CNO cycle describing the hydrogen burning in stars. Or Explain the construction and working of a GM Counter.	**CO2**
Q 8	Derive an expression for scattering angle and impact parameter.	**CO1**

Q 9	How much water shielding do you require, if you want to reduce the intensity of a 500 keV monoenergetic gamma ray (narrow beam) to 1% of its initial intensity? The half value layer of 500 keV gamma rays in water is $0.097cm^{-1}$.	**CO4**
	Section C **1. Each Question carries 20 Marks.** **2. Scan and Upload**	
Q10	(a) Describe the different processes through which gamma rays interact with matter.(10) (b) Explain the different constituents of the semi-empirical mass formula. The binding energy of an element is 64 MeV, binding energy per nucleon is 6.39 MeV. What are the total number of neutrons and protons in the nucleus? (10) **OR** (a) Calculate the work function, stopping potential, and maximum velocity of photoelectrons for a light of wavelength 4350Å when it incidents on sodium surface. Consider the threshold wavelength of photoelectrons to be 5420Å. (10) (b) Draw the chart depicting the classification of fundamental particles based upon their spin. (10)	**CO3**
Q11	(a) Explain the construction and working of a Betatron. Also derive the Betatron condition. (10) (b) Explain the big bang nucleosynthesis. (10)	**CO1**