

Name:	
Enrolment No:	

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

Course: Nuclear and Particle Physics	Semester: I
Program: B.Sc. Mathematics (Hons), B.Sc. Chemistry (Hons)	Time 03 hrs.
Course Code: PHYS 2012G	Max. Marks: 100

SECTION A

1. Each Question will carry 5 Marks
2. Instruction: Complete the statement / Select the correct answer(s)/Write short answers

S. No.	Question	CO
Q 1	Mention the different methods used to determine the nuclear radius. Explain why nuclear density is constant.	CO1
Q2	a) The numerical value of the binding energy of tritium is _____. (2) b) The nuclear force is of _____ range, _____ dependent and _____ independent. (3)	CO1
Q3	a) According to the shell model, the spin and the spin and parity of $^{63}_{29}\text{Cu}$ is _____ and _____. (2) b) State the successes of the Fermi- Gas model. (3)	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
Q6	Select all the correct statement: i) The magnetic moment of a neutron is zero as it is charge neutral. ii) The binding energy curve can be used to describe fission and fusion. iii) The top quark is the heaviest quark. iv) Cockcroft Walton accelerator is an electrostatic type accelerator. v) The most abundant element in the universe is iron	CO4

SECTION B

1. Each question will carry 10 marks
2. Instruction: Write short / brief notes

Q 7	Estimate the thickness of lead (density 11.3 g 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 8	Explain the CNO cycle describing the hydrogen burning in stars.	CO2
Q 9	Derive an expression for scattering angle and impact parameter.	CO1
Q 10	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
Q 11	Explain the construction and working of a GM Counter.	CO3
Section C		
<p>1. Each Question carries 20 Marks.</p> <p>2. Instruction: Write long answer.</p>		
Q12	<p>(a) Describe the different processes through which gamma rays interact with matter.(10)</p> <p>(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)</p> <p style="text-align: center;">OR</p> <p>(a) Calculate the work function, stopping potential, and maximum velocity of photoelectrons for a light of wavelength 4350\AA when it incidents on sodium surface. Consider the threshold wavelength of photoelectrons to be 5420\AA. (10)</p> <p>(b) Draw the chart depicting the classification of fundamental particles based upon their spin. (10)</p>	CO3