

Name:  
Enrolment No:



**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**Online End Semester Examination, December 2020**

**Course: Nuclear and Particle Physics**  
**Program: BSc Physics (Hons.)**  
**Course Code: PHYS3012**

**Semester: V**  
**Time 03 hrs.**  
**Max. Marks: 100**

**SECTION A**

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

S. No.	Question	CO
Q 1. (a)	The isotones are the nuclei having [2] (i) same number of neutrons (ii) same atomic mass (iii) same number of protons (iv) same mass number	CO1
(b)	The ratio of the nuclear radii of <sup>27</sup> Al to that of the <sup>125</sup> Tl is _____. [3]	
Q2. (a)	The numerical value of binding energy of deuteron is _____. [2]	
(b)	The nuclear force is of _____ range, _____ dependent and _____ independent. [3]	CO1
Q3. (a)	According to the Shell model the spin and parity of <sup>17</sup> O is ____ and _____. [3]	CO2
(b)	In liquid drop model the surface energy term is proportional to mass number as [2] (i) A (ii) A <sup>1/3</sup> (iii) A <sup>-1/3</sup> (iv) A <sup>2/3</sup>	
Q4.	Select all the correct statements [5] (i) The magnetic moment of a neutron is zero, as it is charge neutral (ii) The binding energy curve can be used to describe nuclear 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 universe is iron.	CO4
Q5.	The particle physics reactions which are allowed as per Lepton number conservation are [5] (i) $p \rightarrow n + e^+ + \nu_e$ (ii) $\mu^+ \rightarrow e^+ + \nu_e + \bar{\nu}_\mu$ (iii) $p + e^- \rightarrow n + \nu_e$ (iv) $K^- \rightarrow \mu^- + \bar{\nu}_\mu$ (v) $n \rightarrow p + e^- + \nu_e$	CO3
Q6.	The possible multipole $\gamma$ ray transitions for following pair of nuclear states will be [5] (i) $3^- \rightarrow 2^+$ (ii) $(\frac{1}{2})^- \rightarrow (\frac{1}{2})^+$	CO3

**SECTION B**

- 1. Each question will carry 10 marks**  
**2. Instruction: Answer the following questions in 200 words**

Q 7	Write short notes on (i) elementary particles (ii) GM counter	<b>CO1</b>
Q.8.	$^{13}\text{N}$ is a positron emitter with an end point energy of 1.2MeV. Determine the threshold of the reaction $p + ^{13}\text{C} \rightarrow ^{13}\text{N} + n$ , if the neutron – hydrogen atom mass difference is 0.78MeV.	<b>CO2</b>
Q.9.	Briefly describe the r-process and the s-process for synthesis of heavy elements	<b>CO4</b>
Q.10.	A radioactive substance of half-life 100 days which emits $\beta$ -particles of average energy $5 \times 10^{-7}$ ergs is used to drive a thermoelectric cell. Assuming the cell to have an efficiency 10%, calculate the amount (in gram-molecules) of radioactive substance required to generate 5W of electricity.	<b>CO4</b>
Q.11.	Explain the principle, construction and working of a cyclotron	<b>CO3</b>

**Section C**

- 1. Attempt any one.**  
**2. Instruction: Answer the following questions in about 400 words.**

Q12. (a)	Describe the different processes through which gamma ray interact with matter. [10]	<b>CO3</b>
(b)	Describe the Semi empirical mass formula. The binding energy of an element is 64 MeV, Binding energy per nucleon is 6.39 MeV. What is the total number of neutrons and protons in the nucleus? [10]	
OR		
(a).	Calculate the magnetic field and the Dee radius of a cyclotron which could accelerate protons to a maximum energy of 5 MeV if the available radio frequency is of 8 MHz. [10]	
(b).	Describe the principle construction and working of LINAC. [10]	