Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

Course: Nuclear and Particle Physics **Semester : II**
Program: MSc Physics **Time : 03 hrs.**
Course Code: PHYS 7012 **Max. Marks: 100**

SECTION A
(5Qx4M=20Marks)
Attempt All Questions. Each Question will carry 4 Marks

S. No.		Marks	CO
Q1	Describe the mirror nuclei method for nuclear radius determination.	**4**	**CO1**
Q2	Show that pair production cannot take place in empty space.	**4**	**CO1**
Q3	Determine the spin and parity of the $^{17}_{8}O$ and $^{89}_{38}Sr$ nucleus	**4**	**CO2**
Q4	The ground state of Pb-207 has spin-parity $J^{\pi}=\frac{1}{2}^{-}$ while the first excited state has. $J^{\pi}=\frac{5}{2}^{-}$ Determine the electromagnetic radiation emitted when the nucleus makes a transition from the first excited state to ground state.	**4**	**CO3**
Q5	The particle physics reactions which are allowed as per Lepton number conservation are (i) $p \rightarrow n + e^{+} + \nu_e$ (ii) $\mu^{+} \rightarrow e^{+} + \nu_e + \bar{\nu}_u$ (iii) $p + e^{-} \rightarrow n + \nu_e$ (iv) $K^{-} \rightarrow \mu^{-} + \bar{\nu}_u$ (v) $n \rightarrow p + e^{-} + \nu_e$	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Each question will carry 10 marks (10×4 = 40 Marks)
There is an internal choice for Q9.

Q6	Discuss important points of the Fermi's theory of beta decay	**10**	**CO3**
Q7	Enumerate the similarities of nucleus with a liquid drop and hence obtain an empirical relation for binding energy of a nuclei, describing each of the terms.	**10**	**CO2**
Q8	Define reaction cross-section and obtain expression for reaction rate.	**10**	**CO3**
Q9	Briefly explain the tunnel theory of alpha decay.	**10**	**CO2**

	OR Describe the Rutherford gold foil experiment and hence obtain expression for total scattering cross-section	**10**	
SECTION-C **(2Qx20M=40 Marks)** **1. Each Question carries 20 Marks.** **2. Attempt two questions. There is an internal choice for Q11.**			
Q10	a) Explain the different types of interaction describing the strength, range and the intermediate particles of interaction for each. b) Describe the different conservation principles in relation to elementary particles giving example of each.	**10** **10**	**CO4**
Q11	a) Obtain the classical expression given by Bohr for stopping power of charge particles in matter. b) Describe the different interaction mechanism of gamma radiation with matter. OR Define Q-value of a nuclear reaction. Obtain an expression for it and hence write the condition for exoergic and endoergic nuclear reaction.	**20**	**CO 3**