Name:

Enrolment No:

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

Course: Nuclear and Particle Physics **Semester: IV**
Program: B. Sc. (H) Mathematics IV, Chemistry IV, Geology IV **Time: 03 hrs.**
Int. B. Sc.-M. Sc. Mathematics IV, Chemistry IV **Max. Marks: 100**
Course Code: PHYS2012G

Instructions:

- All questions are compulsory (**Q9** and **Q11** have an internal choice)
- Scientific calculators can be used for calculations.

SECTION A
(5Q x 4M=20 Marks)

S. No.		Marks	CO
Q 1	What is the difference between mass defect and packing fraction?	**4**	**CO1**
Q 2	What are the various ways in which a radioactive nucleus decay?	**4**	**CO2**
Q. 3.	Half-life of $^{11}Na^{24}$ is 15 hours. How long does it take for 93.75% of a sample of this isotope to decay?	**4**	**CO2**
Q.4.	A sample of uranium emitted α-particles of energy 4.18 MeV is placed near ionization chamber. Assuming that, only 10 particles/sec enter the chamber, calculate the current produced. Given 1 ion pair requires 35 eV.	**4**	**CO3**
Q.5.	Classify the various types of interactions in relation with elementary particles.	**4**	**CO4**
	SECTION B **(4Q x 10M= 40 Marks)**		
Q 6	Derive the semi-empirical mass formula and discuss the contribution of various terms to the binding energy of nucleus.	**10**	**CO1**
Q.7	Explain the nuclear reaction kinematics in detail. What is Q-value of nuclear reaction? Explain its significance.	**10**	**CO2**
Q.8	Derive an expression for the change in wavelength when a gamma ray photon undergoes Compton scattering.	**10**	**CO2**
Q.9	Protons are accelerated in a cyclotron with dees of radius 32 cm and magnetic field of 6500 Gauss. Calculate (i) the velocity of the protons (ii) the energy in MeV and (iii) frequency of A.C. voltage between the dees.	**10**	**CO3**

	OR What is the Van-de-Graaf generator? What is it frequently used for? Can it be used to accelerate protons and electrons?		
	SECTION-C **(2Q x 20M=40 Marks)**		
Q 10	(a) Describe the construction, principle and working of an ionization chamber. Explain the difference between ionization chamber and G. M. counter.	**10**	**CO3**
	(b) What are fundamental particles? Give a brief account of the discovery and properties of elementary particles.	**10**	**CO4**
Q. 11	(a) The photoelectric work function of potassium is 2.0 eV. If light having a wavelength 3600 angstrom falls on potassium, find (i) the kinetic energy in eV of the most energetic electrons ejected, (ii) the stopping potential (iii) the velocity of these electrons.	**10**	
	(b) Write short notes on; (i) Artificial radioactivity, and (ii) compound nucleus theory of nuclear reactions.	**10**	
	OR		**CO2**
	(a) What are the various types of nuclear reactions? Give at least one example for each case.	**10**	
	(b) A certain radioactive substance has a disintegration constant $\lambda = 1.44\times10^{-3}$ per hour. In what time will 75% of the initial number of atoms disintegrate?	**10**	

Values of constants:

Constant	Standard Values
Rest mass of an Electron	9.11×10^{-31} Kg
Charge of electron	1.6×10^{-19} C
Speed of light	3×10^{8} ms^{-1}
Plank's constant	6.63×10^{-34} Js
Mass of Proton/Neutron	1.66×10^{-27} kg
Mass of Proton	1.00759 a.m.u.
Mass of Neutron	1.00898 a.m.u.