JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2024

MSc-III Semester (PMS)

COURSE CODE (CREDITS): 3 MAX. MARKS: 25

COURSE NAME: Nuclear and Particle Physics (18MS1PH318)

COURSE INSTRUCTORS: HSR MAX. TIME: 1 Hour 30 Minutes

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q.No	Question	Marks
Q1.	Two radioactive sources each have activities of 1 μCi at t=0. Their half lives are, respectively, 1.0 s and 1.0 hr. (a) How many radioactive nuclei are present at t=0 in each sources? (b) How many nuclei of each source decay between t=0 to t=1 s? (c) How many nuclei decay between t=0 and t= 1 hr? (1 Ci = 3.7 x 10^{10} decays / s)	4
Q2.	Derive the expression for the Volume, Surface, Coulomb and Aysmmetry terms in the semi-empirical formula for the binding energy.	5
Q3.	Masses of ^{15}O and ^{15}N are 15.0030656 u and 15.000108899 u respectively. (a) Compute the difference in the Binding Energy. (b) Assuming this difference to arise from difference in the Coulomb energy, compute the nuclear radius of ^{15}O and ^{15}N. (1 u = 931.5 MeV)	4
Q4.	Using uncertainty principle, explain why an electron can never be found inside a nucleus.	4
Q5.	Discuss and derive the radioactive decay law. Using this, in the chain of decays $1 \rightarrow 2 \rightarrow 3$ ..., derive the expression for the number of daughter nuclei 2 as a function of time ($N_2(t)$). Assume that $N_1(t = 0) = N_0$ *and* $N_2(t = 0) = N_3(t = 0) = 0$.	5
Q6.	Consider a simple decay process in which an initial number N_0 of radioactive nuclei A decay to stable nuclei B. In a time interval from t_1 *to* $t_1 + \Delta t$, how many decays will occur?	3