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| **Date:7-12-2020** |

 **ST.JOSEPH’S COLLEGE (AUTONOMOUS), BANGALORE-27.**

**M.Sc. PHYSICS - IV SEMESTER**

**SEMESTER EXAMINATION: NOVEMBER 2020.**

**PH-0218 : NUCLEAR AND PARTICLE PHYSICS**

**Time: 2 1/2 hours Max Marks: 70**

This paper contains 2 printed pages and 3 parts

**PART A**

**Answer any five questions. Each question carries 10 marks. (5x10=50 marks)**

1. a. On what principle can electrons be used to calculate the size of a nucleus?

 Explain with an example. Why EM waves cannot be used for the same. (5)

b. Briefly explain the properties of nuclear Forces. (5)

 2. Obtain an expression for the number of attempts alpha particle makes per

 unit time approximating the barrier to be rectangular one as postulated

 by George Gamow (10)

1. a. Deduce a relation for the energy of a particle in lab frame and center of mass frame for a nuclear reaction. (5)

 b. Explain Compound nuclear reaction with a suitable example. (5)

1. With a neat diagram, explain the construction and working principle of a drift tube    linear accelerator. Obtain an expression for the maximum velocity attained by the particle.                                                                                          (10)
2. a. What are the quantum numbers that need to be conserved for a particle reaction? (4)

b. Write a note on CP violation in K decay. (6)

1. Draw Feynman diagrams for the following phenomena

a. Photoelectric effect b. Compton scattering c. Bremsstrahlung radiation

d. β+ decay e. β- decay f. Electron capture

g. One pion exchange (10)

 7. a. Briefly explain pion nucleon interactions (4)

b. How are particles classified under standard model. Explain (6)

 **PART B**

 **Solve any four problems. Each problem carries 4 marks. (4x4 = 16 marks)**

 1 amu = 1.67 x 10-27 Kg; mp = 1.0081 amu; mn = 1.0087 amu; mα = 4.0026 amu;

1. amu = 931 MeV
2. 14Si27 and 13Al27 are mirror nuclei. The former is a positron emitter with Emax = 3.48 MeV. Determine ro.
3. Calculate the activity of K40 in 100 gm mass assuming that 0.35 % of the body weight is potassium. The abundance of K40 is 0.012 % and its half life is 1.31 x 109 years.
4. Compute the velocity of α-particles emitted by a radio-nuclide having half-life of 1620 years. The energy emitted by the α-particle is 4.8 MeV. Also find the probability of α- emission. Given: radius of the residual nucleus is 7.9 fm.
5. Calculate the energy generated in MeV when 0.1 kg of 3Li7 is converted to 2He4 by proton bombardment. Given: Masses of 3Li7, 2He4 , 1H1 in amu are 7.0183, 4.0040, 1.0081 respectively.
6. A cyclotron with dees of radians 1.1 m operates with a transverse magnetic field of 0.7 Wb/cm2. Calculate the energies to which (i) protons (ii) α-particles are accelerated.

**PART C**

**Answer any two questions. Each question carries 2 marks.          (2x2 = 4 marks)**

1. What is the advantage of using colliding beams in particle accelerators?
2. Which class of elementary particles doesn’t experience strong interaction? Why?
3. What are strange particles? Write a particle reaction that conserves strangeness.
4. If graviton were to be discovered in future, in which category would it be classified in the standard model? Explain.
5. What lead physicists to introduce the quantum property of color.

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