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| **Register Number:**  **Date:** |

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

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

**SEMESTER EXAMINATION: APRIL 2019.**

**PH 0216 : NUCLEAR AND PARTICLE PHYSICS**

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

This paper contains 2 printed pages and 2 parts

**Part A**

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

1. Assuming modified radial wave equation for deuteron, arrive at the final wave equation by applying boundary conditions. (10)
2. Give Gamow’s theory of α- decay and obtain an expression for decay constant. (10)
3. a. Explain cross section of a nuclear reaction. Deduce an expression for the number of     particles scattered by the target. (5)

b. Explain the energetics of nuclear reaction and obtain an expression for the kinetic      energy of the ejected particle. (5)

1. a. What is the importance of particle accelerators? (2)

b. 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.      (8)

5. a. Explain the role of mesons as exchange particles. (4)

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

6. a. Explain different quantum numbers that need to be conserved in production and decay                of elementary particles. (5)

b. How are particles classified under standard model. Explain (5)

7. a. What is the advantage of using colliding beams in particle accelerators? (2)

b. What are strange particles? Write a particle reaction that conserves strangeness. (3)

1. If graviton were to be discovered in future, in which category would it be classified in the standard model? Explain. (2)
2. What lead physicists to introduce the quantum property of color. (3)

**PART B**

**Solve any four problems. Each problem carries 5 marks. (4x5 = 20 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

1. Calculate the distance of closest approach of α-particles to the Zinc nucleus (Z=30), when α-particles of energy 5 MeV are scattered back by a thin sheet of zinc. What would be the closest approach of a deuteron of the same energy to the zinc nucleus? (5)
2. A sample contains 5 mg of Ra which has a half-life is 6 days and the average energy of β particles emitted is 0.4 MeV, at what rate does the sample emit energy? Given: mass number of Ra - 210. (5)
3. 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)
4. 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. (5)
5. 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 can be accelerated.                                                                                                                                        (5)
6. a. If a proton of energy 20 MeV interacts with the target nucleus, calculate the approximate time of its interaction with the nucleus. (3)

b. An exchange particle’s mass is found to be 135 MeV, find the uncertainty in time of its existence. (2)