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| **Register Number:****Date: 11-04-2019** |

** 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. a. Explain mirror nuclei method to determine the nuclear radius. (6)

 b. Explain any four properties of nuclear forces.                                 (4)

 2. a. What was the mystery behind β particle spectrum? Explain in detail the theory

 put forth by Fermi. (8)

 b. What is Fermi function? Mention its significance. (2)

1. a. Using the diagram provided on page 2 explain compound nuclear reaction with an      example. (6)

 b. Explain resonance nuclear reaction with an example (4)

 4. a. Given an account of different types of particle accelerators. (2)

 b. With a neat diagram explain the working of a Synchrotron and also obtain the

 maximum energy attained in the synchrotron. (8)

 5. a. Explain Yukawa’s meson theory on nuclear forces. (4)

 b. Explain CP violation in K decay. (6)

 6. a. Write a short note on Feynman diagrams. How are they helpful in understanding the                  reactions of elementary particles? (5)

 b. Explain standard model and the particles classified under this model. (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. Briefly explain Quantum Chromo dynamics (5)

**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 silver nucleus (Z=47), when α-particles of energy 7 MeV are scattered back by a thin sheet of silver. What would be the closest approach of a proton of the same energy? (5)
2. A sample contains 8 mg of Ra which has half-life of 6 days. The average energy of

β-particles emitted is 0.35 MeV, at what rate does the sample emit energy? Given: mass number of Ra - 210. (5)

1. A radio-nuclide emits α-particles of velocity 1.516 x 107 ms-1 and has half-life of 1620 years. Compute the energy of α-particles and the probability of α-emission. Given: radius of the residual nucleus is 7.9 fm. (5)
2. In a nuclear reactor, fission is produced in 1 g of 92U235 (235.0439 amu) in 24 hours by a slow neutron. Assuming that 36Kr92 (91.8973 amu) and 56Ba141 (140.9139 amu) are produced in all reaction and no energy is lost, write the complete reaction and calculate the total energy produced and express it in kWh. (5)
3. A linear accelerator, accelerating protons, has a length 5 cm for the first drift tube and the energy attained by protons is 100 MeV. The frequency of the r.f-field applied is 500 MHz. The time taken by the proton to travel the distance between two consecutive gaps is equal to half the period of r.f-field. Find (i) the length of the last tube (ii) energy of protons at injection into the first tube. (5)
4. a. If a proton of energy 200 MeV interacts with a 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)

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**Diagram**

**PH 0216-A-19**