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

M.Sc. PHYSICS - IV SEMESTER
SEMESTER EXAMINATION: APRIL 2022.
(Examination held in July 2022)
PH - 0218 : NUCLEAR AND PARTICLE PHYSICS
Supplementary Examination

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 marks)

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. Which nuclear reaction gives a peaked distribution? Direct or compound. Why?   (5)
   b. What led to the invention of strangeness quantum number?   (5)
4. a. What are particle accelerators? Given an account of different types of 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 the role of mesons as exchange particles.   (4)
   b. Write a note on CP violation in K decay.   (6)
6. Explain Standard model, how are particles classified under this model.   (10)
7. Explain different quantum numbers that need to be conserved in production and decay of elementary particles.   (10)

PART B
Answer any four questions. Each question carries 5 marks.   (4x5=20)

8. Find the fermi factor in the below beta decay process when the speed of the electron/positron is measured to be 0.2c.

$$^{22}_{11}\text{Na} \rightarrow {}^{22}_{10}\text{Ne} + \beta^+ + \nu$$
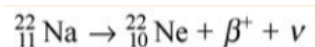
9. An atom bomb consisting of U-235 explodes and releases the energy of 10^{14} J. It is known that each U-235 that undergoes fission releases 3 neutrons and about 200 MeV of energy. Further, only 20% of the U-235 atoms in the bomb undergo fission. What is the mass of U-235 used?

10. Let's consider that protons and neutrons possess equal masses, then in what order will be the ratio of the density of the nucleus to the density of water.

11. Protons of energy 1 MeV undergo Rutherford scattering against nuclei of gold Z = 79. Calculate the distance of the closest approach.

12. A nucleus with A = 235 splits into two nuclei whose mass numbers are in the ratio of 1:2. What is the radius of the newly formed larger nucleus?

13. $T_{1/2}$ of radioactive material is 4 days. After 20 days, what fraction of it remains undecayed.