



Date:

Registration number:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
M.Sc. PHYSICS - IV SEMESTER
SEMESTER EXAMINATION: JULY 2022
(Examination conducted in April 2022)

PH0220 – NUCLEAR AND PARTICLE PHYSICS

Time- 2 ½ hrs

Max Marks-70

This question paper contains Two printed pages and Two parts

Part A

Answer any FIVE questions. Each question carries 10 marks

[5 x 10 = 50]

- (i). Obtain the expression of the magnetic dipole moment of a nucleus. [7]

(ii). How does the Fermi distribution formula for nuclear charge distribution help to estimate the value of nuclear radius? [3]
- (i). Explain the Bohr-Wheeler theory of nuclear fission with a neat diagram and obtain the critical parameters. [7]

(ii). Calculate the ground state spin and parity of the (i) ${}_{8}\text{O}^{16}$ and (ii) ${}_{7}\text{N}^{15}$ nucleus. [3]
3. Prove that the total scattering cross-section is equal to twice that of the geometrical scattering cross-section. [10]
- (i). Briefly explain the working of a GM counter. [8]

(ii). Why does a spark chamber require the electric clearing fields? [2]
5. Explain briefly the symmetries and conservation laws involved in particle physics. [10]
- (i). Discuss the Fermi theory of β -decay in detail. [8]

(ii). Write a short note on the collective nuclear model. [2]
- (i). Set up the Schrodinger wave equation for the ground state (s-state) of deuteron assuming a square well potential and solve it. Establish the condition for the bound state. [8]

(ii). The radius of Ge nucleus is measured to be twice the radius of ${}_{4}\text{Be}^9$. How many nucleons are there in Ge nucleus? [2]

Part B

Answer any FOUR questions. Each question carries 5 marks

[4 x 5 = 20]

8. Discuss the CP violation process in the K-meson decay.
9. (i). Classify the elementary particles based on their life time.
(ii). Obtain the isospin states ($|I, I_3\rangle$) for nucleons. [3+2]
10. Obtain the condition for spontaneous fission.
11. Which of the following interaction is allowed or forbidden in nature? Also, if it is an allowed interaction, mention the type of interaction.
(i) $K^- + p \rightarrow \Sigma^- + \pi^+$
(ii) $\mu^- + \mu^+ \rightarrow K^- + K^+$
12. Write down the Bethe and Weiszacker's semi-empirical mass formula and explain the significance of each term.
13. (i). What do you mean by the infrared slavery?
(ii). Why does quark get effective mass in hadrons? [3+2]