

Registration Number:

Date & Session:



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

M.Sc. PHYSICS – IV SEMESTER

SEMESTER EXAMINATION: APRIL 2023

(Examination conducted in May 2023)

PH 0220: NUCLEAR AND PARTICLE PHYSICS

(For current batch students of only)

Time: 2 ½ Hours

Max Marks: 70

This paper contains 2 printed pages and 2 parts

PART-A

Answer any FIVE questions. Each question carries 10 marks

5×10=50

1. Elaborate on how the nuclear radius is estimated using the electron Scattering method. **(10)**
2. Give an account of the theory of α -emission from radioactive substances. **(10)**
3. (a) Explain how the optical model accounts to the elastic scattering in the presence of absorptive effects in a general way.
(b) Write a short note on isospin. **(8+2)**
4. Describe the construction and working of a semiconductor detector with a neat diagram. List its advantages and limitations. **(10)**
5. (a) Discuss Yukawa's hypothesis in detail.
(b) Classify elementary particles based on the following: (i) Mass and (ii) Spin **(6+4)**
6. (a) Why is CP violation not observed in other particle reactions?
(b) Contrast the electric field of two charges and the color field of two quarks using a diagram. **(6+4)**
7. (a) Briefly explain why a Deuteron cannot have an excited state.
(b) Diproton and dineutron do not exist in nature. Why? **(5+5)**

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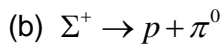
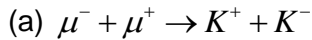


PART-B

Answer any FOUR questions. Each question carries 5 marks

4×5=20

8. Which of the following reactions is allowed or forbidden?



9. A 280-day-old radioactive substance shows an activity of 6000 disintegrations per second, 140 days later, its activity is 3000 disintegrations per second. What was its initial activity?

10. The shell model energy levels of nucleons are,

$$^1s_{1/2}, ^1p_{3/2}, ^1p_{1/2}, ^1d_{5/2}, ^2s_{1/2}, ^1d_{3/2}, ^1f_{7/2}, ^2p_{3/2}, ^1f_{5/2}, ^2p_{1/2}, ^1g_{9/2}, ^2d_{5/2}, ^2d_{3/2}, ^3s_{1/2}, ^1h_{11/2}, \dots$$

Assuming that the shells are filled in the order written, what spin and parities should be expected for the ground state of the following nuclei?



11. Consider the liquid drop model, use binding energy formula to find the value of atomic number (Z_0) of the most stable nuclei among the members of an isobaric family ${}_Z\text{A}^X$.

12. Electrons are accelerated to get maximum kinetic energy in a cyclotron under the influence of a magnetic field of 3.2 Wb/m^2 . Calculate the frequency of revolution of the emerging electron. Given: $e=1.6 \times 10^{-19} \text{ C}$, $m=9.1 \times 10^{-31} \text{ kg}$.