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Reg. No. | | | | | | | | |

III Semester M.Sc. Degree Examination March/April-2025

PHYSICS

Nuclear and Particle Physics (General)

(CBCS New Scheme 2020-21)

Paper : PHY303

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

All questions are Compulsory.

I. Answer any THREE questions. **(3×15=45)**

1. Discuss in detail the three principal processes through which gamma rays interact with matter.

(OR)

2. a) What are nuclear reactions? Why one has to study the nuclear reactions?

   b) What is Bohr's independence hypothesis? Discuss its experimental evidence.

   c) Discuss neutron cycle in a thermal reactor and deduce the four factor formula. **(3+5+7)**

3. a) With a neat sketch, explain the working principle of semiconductor detectors.

   b) Deduce the expression which relates the applied voltage and depletion region thickness in junction type detectors. **(5+10)**

(OR)

4. a) What are nuclear models? Why one has to study various nuclear models?

   b) Using semi empirical mass formula, obtain the expression for finding the most stable nuclei among the given isobaric family. Explain the same with a specific example. **(3+12)**

5. a) Discuss with specific examples, the various types of interaction between hadrons, leptons and neutrinos.

   b) Discuss C-P violation in neutral kaon decay. **(9+6)**

(OR)

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6. a) What are strange particles? Why do we call them so? Explain with specific example.

b) Explain Gellmann's eight fold way classification of baryons and mesons in terms of SU(3) octet and decuplet diagrams. **(4+11)**

Answer any FIVE of the following questions. **(5×5=25)**

7. a) Write a note on Bremsstrahlung radiation.

b) What do you mean by threshold energy of nuclear reaction? Calculate the threshold energy of the nuclear reaction $^{25}Mg(\alpha,d)\ ^{27}Al$. Given: The masses of Mg, α, d and Al nuclei are 24.9868 amu, 4.0026 amu, 2.0140 amu and 26.9815 amu respectively.

c) What do you mean by resolution of a spectrometer? Explain.

The gamma spectrum of Cs-137 source recorded using scintillation spectrometer shows the full energy peak at 890th channel number. Calculate its resolution.

d) Predict the ground state spin and parity of ^{17}O and ^{27}Al.

e) Check whether the following reactions are possible or not. Justify your answer.

i) $K^+ \rightarrow \pi^+ + \pi^+\pi^-$

ii) $K^+ \rightarrow \pi^+ + \pi^0$

f) Write down the quark contents of proton, neutron, $\wedge^0$ baryon and K^0 meson.