

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034



M.Sc. DEGREE EXAMINATION – PHYSICS

FOURTH SEMESTER – APRIL 2022

PPH 4502 – NUCLEAR PHYSICS

Date: 17-06-2022

Dept. No.

Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

PART – A

Q. No **Answer ALL Questions** **(10 x 2 = 20 Marks)**

- 1 Write a note on the Yukawa's field particle.
- 2 An α -particle of energy 7 MeV is scattered through 180° by a Uranium nucleus. Calculate the distance of closest approach between the nucleus and the α -particle.
- 3 Find the BE/A of ${}_{29}\text{Cu}^{64}$. Given $M_n = 1.008665$ u, $M_H = 1.007825$ u, $M_{\text{Cu}} = 63.929759$ u.
- 4 What are magic numbers?
- 5 State the condition for continuum in compound nucleus energy levels.
- 6 Differentiate between super-criticality and sub-criticality in nuclear reactors.
- 7 Write down the Geiger-Nuttal Law and explain the various terms in it.
- 8 Distinguish between a neutrino and anti-neutrino.
- 9 What are baryons?
- 10 Verify if Baryon number is conserved in the following reaction: $\pi^- + p \rightarrow \pi^0 + \Lambda^0$.

PART – B

Answer any FOUR Questions **(4 x 7.5 = 30 Marks)**

- 11 Give an account of the exchange forces in the nucleus.
- 12 Write a note on the striking similarities of the liquid drop and the nucleus.
- 13 Derive the four factor formula for controlled chain reactions.
- 14 Describe the Gamow Teller selection rules for beta decay.
- 15 What are Quarks? Give the Quark composition of i) mesons ii) protons and iii) antiprotons.
- 16 Explain the classification of elementary particles with a schematic.

PART – C

Answer any FOUR Questions **(4 x 12.5 = 50 Marks)**

- 17 Discuss with necessary theory how the electron scattering experiments lead to the determination of nuclear size.
- 18 Derive the Weizsacker's semi empirical mass formula and explain it in detail.
- 19 Discuss the general aspects of reactor design with a neat diagram.
- 20 Explain Gamow's theory of alpha decay with its mathematical treatment.
- 21 State and elucidate with suitable examples the CPT invariance theorem.
- 22 Discuss in detail the deuteron problem and hence obtain expressions for the range and depth of its potential.

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