TM244211J

MASTER'S DEGREE (C.S.S) EXAMINATION, MARCH 2024
2022 ADMISSIONS REGULAR
SEMESTER IV - CORE COURSE PHYSICS
PH4C12TM20 - Nuclear and Particle Physics

Time : 3 Hours   Maximum Weight : 30

Part A

I. Answer any Eight questions. Each question carries 1 weight   (8x1=8)

1. Distinguish between π-mesic X rays and muonic X rays.

2. Mention the characteristics of nuclear forces.

3. Compare the angular momentum and parity selection rules for allowed and forbidden decays.

4. Explain any three types of nuclear reactions and conservation laws.

5. Draw a plot showing the mass distribution of fragments in thermal neutron induced fission. How does it differ from fast neutron induced fission?

6. Explain electroweak theory.

7. Do the existence of these quarks Δ^{++}, Δ^{-} and Ω^{-} violate Pauli's exclusion principle? Justify your answer.

8. Describe the motivation behind Grand Unified Theory (GUT)

9. Explain Big Bang theory.

10. Describe the three essential components of Rutherford backscattering spectrometry instrument.

Part B

II. Answer any Six questions. Each question carries 2 weight   (6x2=12)

11. Based on semi-empirical mass formula find the expression for minimum value of Z

12. Deduce the differential cross section of Rutherford Scattering.

13. Obtain the ground state spins and parities of the following nuclei and explain the reason. ^{27}Al and ^{58}Ni.

14. Discuss some characteristics of nuclear fusion reaction.

15. Find which of the following reactions are forbidden and justify your answer.

$$\pi^{+} + p \rightarrow p + p + \breve{n} \quad (\breve{n} \text{ is antineutron})$$

$$\Sigma^{+} \rightarrow n + e^{+} + \nu_{e}$$

$$K^{+} \rightarrow \pi^{+} + e^{+} + e$$

16. What are gluons? Discuss their role in the interaction between quarks.

17. Discuss the primordial nucleosynthesis process.

18. Briefly discuss Positron Emission Tomography.

Part C

III. Answer any Two questions. Each question carries 5 weight   (2x5=10)

19. Discuss the partial wave analysis of low energy nucleon-nucleon scattering.

20. Discuss the experimental efforts on the evidences of parity non conservation in beta decay.

21. Discuss the liquid drop model. Obtain the semi empirical mass formula.

22. Explain the basic interactions existing between elementary particles. Under what conditions do the unification of these forces occur?