D3APH2302 **(2 Pages)** **Name.....**
Reg.No.....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2024
(Regular/Improvement/Supplementary)

PHYSICS
FPHY3C10: NUCLEAR AND PARTICLE PHYSICS

Time: 3 Hours **Maximum Weightage: 30**

Part A: Short answer questions. Answer *all* questions. Each carries *one* weightage.

1. Briefly explain the semi empirical mass formula.
2. Write a short note on the non-central nature of nuclear force.
3. What are the constraints to measure nuclear radius?
4. How do hadrons differ from leptons? Explain.
5. Briefly explain scattering length. How is it related to scattering amplitude?
6. Name the four basic forces. Give the relative strengths, range and the particles carrying these forces.
7. Explain the principle of Proportional counter.
8. What do you mean by Comparative half-life? Explain briefly.

(8 × 1 = 8 weightage)

Part B: Essay questions. Answer any *two* questions. Each carries *five* weightage.

9. What is the relevance of Nuclear Shell model? Deduce the energy eigen values of the nucleus on application of a central potential. Plot the splitting of the energy levels of the nucleus considering the spin orbit interaction.
10. Discuss energetics of beta decay and parity violation in beta decay.
11. Describe in detail the neutron proton scattering at low energies and derive expression for phase -shift.
12. Discuss the conservation laws in particle interactions with example in the quark model.

(2 × 5 = 10 weightage)

Part C: Problems. Answer any *four* questions. Each carries *three* weightage.

13. Explain why each of the following cannot exist according to the quark model. (a) A baryon of spin 1. (b) Anti baryon of charge +2.
14. Explain the principle and working of Ionization chamber.
15. An atomic bomb consisting of ^{235}U explodes and releases energy of 1014J. It is known that each ^{235}U which undergoes fission release 3 neutrons and about 200MeV of energy. Further only 20% of the ^{235}U atoms in the bomb undergoes fission. Calculate the total number of neutrons released.

(P.T.O.)

16. With the help of proper diagram explain the working of Photo Multiplier Tube.
17. Find the excitation energies of $^{236}U^*$ and $^{239}U^*$ formed by the capture of thermal neutrons. Using these values, explain why ^{235}U is fissionable, while ^{238}U is not. Assume Mass of ^{235}U= 235.043924u, Mass of ^{236}U = 236.045563u, Mass of ^{238}U = 238.050785u, Mass of ^{239}U = 239.0542905u, Mn = 1.008665u.
18. Give examples for allowed transitions Fermi type and allowed transitions G-T type. What is the type and degree of forbiddenness in the beta decay of the following nuclear transitions?

$(a)\ \frac{1^+}{2} \longrightarrow \frac{3^+}{2}$ (b) $\frac{1^+}{2} \longrightarrow \frac{1^-}{2}$ (c) $\frac{5^+}{2} \longrightarrow \frac{7^-}{2}$

19. Give the quark structure of the following particles.
(a) Proton (b) Ω^- (c) π^+ (d) K^+ (e) μ^-

(4 × 3 = 12 weightage)