

CMDE/M-24

4699

NUCLEAR AND PARTICLE PHYSICS

Paper-PHY-202

Time Allowed : 3 Hours]

[Maximum Marks : 60

Note : Attempt **five** questions in all, selecting **one** question from each Unit. Question No. **1** is compulsory. All questions carry equal marks.

Compulsory Question

1. Answer the following questions :

- (a) Can Compton scattering process take place with k-shell electrons? Explain. 2
- (b) Show that the threshold photon wavelength for producing an Electron-positron pair is 0.0012 nm. 2
- (c) Can you use HPGe detector at 300K ? Explain. 3
- (d) The di-proton and di-neutron are no longer bound systems. Why? 3
- (e) Write down the quark content of the following particles n, π^-, k^+, Ω^- . 2

UNIT-I

2. (a) What do you mean by the 'Bragg's Curve'? Discuss its significance in studying the interaction of a heavy charged particle in a solid. 5
- (b) Explain the concept of mass thickness and mass absorption coefficient. Describe their physical significance. 3
- (c) Explain, how the mass of a meson can be predicted on the basis of meson theory of nuclear forces. 4
3. (a) What is Range Straggling and Energy Straggling? What is the correlation between them? Discuss their physical significance. 7
- (b) 150 keV gamma rays are made to interact in boron and iron targets. Explain how these rays will interact in these mediums. 5

II

UNIT-II

4. (a) Give the schematic diagram of a HPGe detector. Explain how the output signal is generated. 6
- (b) What is the role of a pre amplifier in the pulse processing unit? 2
- (c) If the energy resolution of a scintillation detector is 8.0% for Cs^{137} (662 keV) and 10% for Na^{22} (1280 keV), then which one will be the better. Explain. 4

5. (a) How the Q value of a Nuclear reaction can be calculated? Explain with some example. 3
- (b) Explain the basic principle, construction and working of silicon surface barrier detector. Explain the significance of 'surface barrier' in it. What are its applications? 6
- (c) Why Tl is added in Pure NaI crystal to make it as NaI(Tl) scintillation detector? Discuss. 3

UNIT-III

6. (a) What are different types of Beta decay processes? Explain by giving suitable examples. Discuss the Energetics of Beta decay. 8
- (b) What do you understand by Parity non-conservation property of Neutrino? Discuss. 4
7. (a) Discuss the Wu's experiment for studying the concept of parity. 6
- (b) What do you understand by Fermi-Kurie plot? Explain its importance. 6

UNIT-IV

8. (a) Discuss various kinds of fundamental interactions by giving examples and highlight the field quanta. Compare its relative strength and ranges. 8
- (b) Why free quarks can't be observed? Discuss. 4

9. (a) What was the Motivation to consider Quarks as the building block of matter? Write down the quark contents for Baryons and Mesons. 6
- (b) Why Gravitational interactions are not important in particle physics? 3
- (c) What do you understand by Quark confinement and Asymptotic Freedom? 3