G 18000995

‖‖‖‖‖‖‖‖‖‖
18000995

M.Sc. DEGREE (C.S.S.) EXAMINATION, MAY 2018

Fourth Semester

Faculty of Science

Branch II : Physics–A–Pure Physics

PH 4C 12—NUCLEAR AND PARTICLE PHYSICS

(2012 Admission onwards)

[Common for all]

Time : Three Hours   Maximum Weight : 30

Part A

Answer any **six** *questions.*
*Each question carries a weight of* 1.

1. Draw the binding energy curve and explain its features.

2. Explain how magnetic dipole moment and electric quadrupole moment arise in a nuclei.

3. What are the characteristics of nuclear forces ?

4. What is Fermi-Kurie plot ?

5. What is compound nuclear reaction and direct reaction ?

6. Explain the concept of effective cross-section in nuclear reactions.

7. Explain the collective model of nucleus.

8. What is a thermonuclear reaction ? Illustrate it with an example.

9. What is strangeness ? Explain conservation of strangeness.

10. What is meant by Quantum Chromodynamics ?

$(6 \times 1 = 6)$

Part B

Answer any **four** *questions.*
Each question carries a weight of 2.

11. Calculate the density in gram/cm^3 for the nuclei ^{197}Au ?

12. Calculate the Q-value of the following reaction ?

$_1H^3 + {}_1H^2 \rightarrow 2He^4 + {}_0n^1$.
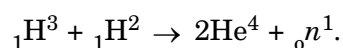
$m(_1H^3) + 3.0169982$ u, m ($2He^4$) $= 4.0038727$ u.

$m(_1H^2) + 2.0147361$ u, 3 $(_0n^1) + 1.0089932$ u.

Turn over

‖▌‖▌‖▌‖‖▌

13. Obtain the spin and parity for the ground states of $_8O^{17}$, $_{13}Al^{27}$, $_{20}Ca^{40}$, $_{28}Ni^{61}$ using nuclear shell model.

14. Which of the following processes are absolutely forbidden and why ?

    (i) $\pi^+ + n \rightarrow \pi^- + P.$ (ii) $\pi^o + n \rightarrow \pi^- + \bar{P}.$

    (iii) $n \rightarrow p + \bar{e} + \bar{v}_e.$ (iv) $\pi^o + \pi^- \rightarrow \bar{n} + P.$

15. P^{32} emits a beta particle with E = 1.71 MCV. Calculate the maximum recoil energy imposed to the nucleus by the beta-particle emission.

16. Analyse the following reactions for possible violations of basic conservation laws.

    (i) $\bar{v}_e + p \rightarrow n + \mu^+.$

    (ii) $\pi^+ + n \rightarrow k^o + \bar{K}.$

$(4 \times 2 = 8)$

Part C

*Answer **all** questions.*
Each question carries weight of 4.

17. Discuss the deuteron system in detail considering it as a rectangular square well potential and deduce an expression for the radius of deuteron.

Or

Discuss in detail the basic properties of nucleus.

18. What is neutrino hypothesis ? Give a detailed account of the Fermi's theory of beta decay.

Or

Deduce an expression for scattering cross-section and reaction cross-section.

19. Discuss how shell model together with spin orbit coupling explains the magic numbers.

Or

Discuss the characteristic of nuclear fission, controlled fission reactions and reactors.

20. Discuss the quark model. Explain the quark structure of nucleons and pions.

Or

Illustrate by taking examples the different conservation laws followed by elementary particles.

$(4 \times 4 = 16)$