G 2417 (Pages : 3) Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, JUNE 2015

Fourth Semester

Faculty of Science

Branch II : Physics – A – Pure Physics

PH 4C 12—NUCLEAR AND PARTICLE PHYSICS

(2012 Admission onwards—Regular/Supplementary)

(Common for all)

Time : Three Hours Maximum Weight : 30

Part A

Answer any **six** *questions.*
Weight 1 *each.*

1. Briefly describe magnetic moment of the nuclei.
2. Explain the meson exchange theory of nuclear force.
3. Reason out the general nature of the nucleon = nucleon potential.
4. Explain the collective model of the nucleus.
5. In the semi empirical mass formula, what is 'asymmetry energy' ?
6. What is the role of nutrino in β - decay ?
7. Explain what is meant by CPT theorem.
8. Briefly discuss about colour quantum numbers.
9. Illustrate with an example the conservation laws obeyed in a nuclear reaction.
10. Describe a set up for measuring the neutron scattering cross-section. What is the advantage of using a thin sample of the scatterer ?

(6 × 1 = 6)

Part B

Answer any **four** *questions.*
Weight 2 *each.*

11. Two protons of kinetic energies E_{p_1} , and E_{p_2} respectively collide and form a deutron with kinetic energy E_D, positron of kinetic energy 0.04 M eV and a neutrino of energy Y eV. Obtain an equation to calculate the mass defect of the deutron from the above.

Turn over

12. Consider the following decay $^{17}F \rightarrow {}^{17}O + \beta^+ + \upsilon_e$. Find the maximum kinetic energy of the positron if the atomic masses of ^{17}F and ^{17}O are 17.0075 u and 17.0045 u respectively.

($m_e c^2 = 0.511$ MeV and 1 u is equivalent to 931.5 MeV).

13. The nucleus ^{12}N decays to ^{12}C with Q value 16.38 MeV. Calculate the maximum recoil energy of the daughter nucleus.

14. Find the speeds of alpha particles emitted with energies 2 MeV and 6 MeV.

15. Using semi-empirical mass formula show that a nucleus with mass number A and atomic number Z is unstable against symmetric fission if the relation $\frac{Z^2}{A} > 15$ is approximately satisfied.

16. Determine the type of interaction (strong, weak or elctromagnetic) through the following processes can take place. Give reasons for your answer :

(a) $\bar{n} + p \rightarrow \overset{o}{\wedge} + \overset{o}{K}$.

(b) $K^+ \rightarrow \pi^+ + e^+ + e^-$.

(c) $\pi^o \rightarrow 2r$.

(4 × 2 = 8)

Part C

Answer **all** *questions.*
Weight 4 each.

17. (a) Describe an experiment to determine the nuclear radius and size.

(b) Write a note on quantum properties of nucleons.

Or

(a) State the basic assumptions in the nuclear shell model and discuss the need for introducing a spin-orbit interaction.

(b) Explain why the shell model predictions of nuclear quadrupole moments are in poor agreement with experimental observations.

18. Elucidate the Bohr-Wheeler theory of nuclear fission.

Or

(a) Give the quantum mechanical treatment of the deutron.

(b) Show that the mixing of the S and D states accounts for the magnetic moment of the deutron.

19. (a) Obtain the expression for the rate of probability of β decay using Fermi's theory.

(b) Explain how far the Fermi's theory has succeeded in explaining the experimental findings.

Or

Discuss schematically a nuclear fission reactor.

20. Describe the quark model of hadrons. Discuss the quark contents of baryon octet, baryon decuplet, pseudoscalar mesons and vector mesons. Briefly comment on coloured quarks and QCD.

Or

Explain the eight-fold way and SU (3) model for strong interaction. Discuss CPT invariance.

(4 × 4 = 16)