Reg. No..................................

Name....................................

M.Sc. DEGREE (C.S.S.) EXAMINATION, APRIL 2019

Fourth Semester

Faculty of Science

Branch II—Physics—A—Pure Physics

PH4C12—NUCLEAR AND PARTICLE PHYSICS

(Common for all)

[2012 Admission onwards]

Time : Three Hours   Maximum Weight : 30

Part A

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

1. Sketch and explain the salient features of binding energy curve.

2. Nucleon-Nucleon force is charge independent ? Justify the statement.

3. Explain what is Yukawa hypothesis ?

4. Explain the main features of a resonance nuclear reaction.

5. Explain what is Scattering length.

6. How does neutrino help in the understanding of beta decay ?

7. Illustrate nuclear fusion process with an example.

8. What are magic numbers ? Why there are no magic numbers that are odd ?

9. What are the experimental evidence in support of quark model ?

10. Classify particles based on spins and interaction ?

$(6 \times 1 = 6)$

Part B

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

11. Show that in the β-transformation $_z\mathrm{X}^A \rightarrow {}_{z+1}\mathrm{Y}^A + \bar{\beta} + \bar{\upsilon}$ the Kinetic energy of the recoil nucleus

    is given by $\mathrm{E}_y = \dfrac{\left(\mathrm{Q} + 2\,m_o\,c^2\right)}{2\mathrm{M}y\,c^2}\,\mathrm{E}_m.$

Turn over

12. According to shell model find spin and parity of $_{38}Sr^{89}$, $_{51}Sb^{125}$, $_5B^{11}$, $_{20}Ca^{40}$.

13. The differences in the coulomb energy between the mirror nuclei $_{24}Cr^{49}$, $_{25}Mn^{49}$ is 6.0 MeV. Assuming that the nuclei have a spherically symmetric charge distribution, and l^2 is 1.0 MeV fm, calculate the radius of the $_{25}^{49}Mn$ nucleus.

14. For the following endoergic reactions, find the Q-value and threshold K. E. assuming lighter particle is incident on the heavier at rest.

    (a) $_{35}C^{12} + p \rightarrow n + N^{12}$.

    (b) $^{35}Cl + \alpha \rightarrow n + {}^{38}K$.

15. Compute the mass defects of :

    (a) ^{32}S.

    (b) ^{20}F.

    (c) U^{238}.

    (d) Fe^{56}.

16. Analyse the following decays according to there quark content :

    (a) $\bar{\Omega} \rightarrow \wedge^\circ + \bar{k}$.

    (b) $k^+ \rightarrow \pi^\circ + \bar{\pi}$.

    (c) $\equiv^- \rightarrow \wedge^\circ + \bar{\pi}$.

$(4 \times 2 = 8)$

Part C

*Answer **all** questions.*

Each question carries a weight of 4.

17. (a) Outline the simple theory of deuteron structure using a square well potential of finite depth and width. Obtain the relation between the well parameters and bending energy.

    Or

    (b) Explain semi empirical mass formula ? Give the applications of semiempirical mass formula.

18. (a) Account parity violation in β-decay and describe an experiment to verify it.

Or

(b) Explain different types of nuclear reactions. Define the Q-value of a nuclear reaction ?

19. (a) Derive an expression for the total magnetic moment of the nucleus and explain it with the help of Schmidt diagram ?

Or

(b) Explain the working of a fission reactor ?

20. (a) Explain : (i) Quark model ; and (ii) Confined quarks.

Or

(b) Explain the conservation laws of elementary particles.

$(4 \times 4 = 16)$