D 6724 (Pages : 2) Name.....

Reg. No.....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2016

(CUCSS)

Physics

PHY 3C 10—NUCLEAR AND PARTICLE PHYSICS

(2012 Admissions)

Time : Three Hours Maximum : 36 Weightage

Section A

Answer **all** *questions.*
Each has weightage 1.

1. Explain the meson exchange theory of nuclear force.
2. Explain the collective model of the nucleus.
3. Sketch and explain the salient features of binding energy curve.
4. What is meant by parity of a nuclear state ?
5. Explain the role of neutrino in beta decay.
6. Briefly discuss the colour quantum numbers
7. What is Fermi-Kurie Plot ? What information does it provide ?
8. Explain the main features of a resonance nuclear reaction.
9. Define Q-value and threshold energy for a nuclear reaction.
10. What is CPT Theorem ?
11. What are quarks ? How do these interact with each other to form particles ?
12. What are hadrons ? Discuss their SU(3) classification and its success in predicting new particles.

(12 × 1 = 12 weightage)

Section B

Answer any **two** *questions.*
Each question has weightage 6.

13. Explain the semi-empirical mass formula and obtain an expression for the number of protons (Z) in a nucleus.
14. Give the quantum mechanical treatment of the deuteron. Show that the mixing of the S and D sates accounts for the magnetic moment of the deuteron.

Turn over

15. Discuss the Fermi theory of beta decay. Illustrate how the continuous beta spectrum is explained and what are allowed and forbidden beta transitions ?

16. Discuss in detail various conservation laws and symmetry operations for elementary Particles.

(2 × 6 = 12 weightage)

Section C

Answer any **four** *questions.*
Each question has weightage 3.

17. Calculate the binding energy of the following isobars and their binding energies per nucleons, ${}_{28}Ni^{64}$ = 63.9280 amu ${}_{29}Cu^{64}$ = 63.9298 amu.

Which of these would you expect to be β-active and how would it decay ?

18. The difference in the Coulomb energy between the mirror nuclei ${}^{49}_{24}Cr$, ${}^{49}_{25}Mn$ is 6.0 MeV.

Assuming that the nuclei have a spherically symmetric charge distribution and that e^2 is approximately 1.0 MeV-fm. Calculate the radius of the If ${}^{49}_{25}Mn$ nucleus.

19. Calculate the Q-value for the reactions Al^{27} (d, α) Mg^{25} and Mg^{25} (α, d) Al^{27}. Given, masses of all nuclei are determined accurately with the help of mass spectrometer as : mAl = 26.9901 amu, mMg = 24.9936 amu, mα = 4.0039 amu, m_d = 2.0147 amu.

20. In the fission of ${}_{92}U^{235}$ by a thermal neutron, the fragments found are ${}_{42}Mo^{98}$ and ${}_{54}Xe^{136}$. How many electrons are released in the reaction. Calculate the amount of energy released in the reaction when the masses of ${}_{92}U^{235}$, ${}_{42}Mo^{98}$ and ${}_{54}Xe^{136}$ and neutron in amu are respectively, 235.044, 97.906, 135.907 and 1.009.

21. According to the shell model find the spin, parity of ${}^{40}_{20}Ca$, ${}^{89}_{38}Sr$, ${}^{27}_{13}Al$, ${}^{125}_{51}Sb$, ${}^{61}_{28}Ni$ in their ground state.

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

(i) $p \rightarrow e^+ + \overline{Y}$.

(ii) $n \rightarrow p + e^- + \overline{\nu}_e$.

(iii) $\overline{n} + n \rightarrow \pi^0 + \pi^+ + \pi^-$.

(iv) $\pi^+ + n \rightarrow \pi^- + p$.

(v) $\pi^0 + n \rightarrow \pi^- + \overline{p}$.

(vi) $\pi^0 + \pi^- \rightarrow \overline{n} + p$.

(4 × 3 = 12 weightage)