21000710

QP CODE: 21000710

Reg No : .....

Name : .....

M Sc DEGREE (CSS) EXAMINATION, JULY 2021

Fourth Semester

Faculty of Science

M Sc PHYSICS

CORE - PH010401 - NUCLEAR AND PARTICLE PHYSICS

2019 Admission Onwards

25446EFC

Time: 3 Hours Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. Describe the muonic shift method to determine the nuclear radius.
2. Calculate the binding energy per nucleon (in units of MeV) for ^{9}Be, for which the atomic mass is 9.01219 amu. Particle masses in amu are: proton = 1.007277, neutron = 1.008665, and electron = 0.0005486. Conversion factor for $E = mc^2$ is 931 MeV/amu.
3. How does the nucleon-nucleon interaction vary with the distance of separation?
4. Define Gamow-Teller decay with an example.
5. Explain selection rules for allowed beta decay.
6. Explain different types of nuclear reactions.
7. What is meant by potential scattering or shape elastic scattering?
8. Give the possible isospin states of (a) $\pi^+\pi^-\pi^0$ (b) $\pi^0\pi^0\pi^0$.
9. What is the Feynman diagram? Explain with an example.
10. Define gravitational waves.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Explain the magnetic dipole moment of a nucleus. Do neutrons contribute to the nuclear magnetic dipole moment?
12. What is an effective range theory?
13. Using the semiempirical formula, calculate the total binding energy and the binding energy per nucleon for the following nuclei: (a) ${}^{7}_{3}Li$; (b) ${}^{20}_{10}Ne$
14. With the help of the shell model, give the expected spin and parity for the ground states of (a) ${}^{7}_{3}Li$ (b) ${}^{11}_{5}B$ (c) ${}^{15}_{6}C$ (d) ${}^{17}_{9}F$
15. Calculate the minimum energy that the alpha particle should have to just reach the gold nucleus. The atomic number of gold = 79; mass number = 197. Express the answer in MeV.
16. The Q value of the decay processes $\Sigma^{+} \rightarrow p + \pi^{0}$ and $\Sigma^{-} \rightarrow n + \pi^{-}$ have been determined to be 116 MeV and 110 MeV respectively. Estimate the masses of Σ^{+} and Σ^{-}.
17. Explain the effective mass of free quarks.
18. The planet Jupiter is composed mainly of hydrogen. It has 1.9×10^{27} kg and mean radius 7×10^{7} m. Show that if it were uniformly dense, its gravitational energy per particle would be only 7 eV, too small to ignite nuclear reaction.

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Explain how deuteron can be treated as an ideal system to understand nuclear interactions.
20. Discuss in detail the internal conversion process and its applications.
21. Discuss compound nucleus reaction and direct reaction.
22. Explain the symmetries associated with particle interactions.

(2×5=10 weightage)