Reg. No ..... Name .....

MSc DEGREE END SEMESTER EXAMINATION - MARCH 2020

SEMESTER 4 : PHYSICS

COURSE : **16P4PHYT14 : NUCLEAR AND PARTICLE PHYSICS**

(For Regular - 2018 Admission and Supplementary - 2017, 2016 Admissions)

Time : Three Hours Max. Marks: 75

Section A
Answer All the following (1 mark each)

1. The volume of a nucleus in an atom is proportional to the

   a. mass number
   b. proton number
   c. neutron number
   d. electron number

2. Practically all even-even nucleus have resultant angular momentum, that is nuclear spin I = 0, which indicates that identical nucleous tend to pair their angular momenta is opposite direction. This effect is called (a) Isotopic invariance (b) Parity (c) Pairing effect (d) Gamow effect
3. Nuclei which are β- emitters lie

   a. below the line of β stability
   b. on the line of β stability
   c. above the line of β stability
   d. below the N = Z line.

4. Which one of the following materials can be used as a fuel in the fusion process.

   a. $_{92}U^{235}$ b) $_{36}Kr^{86}$ c) $_{7}N^{14} + _{8}O^{16}$ d) $_{1}D^{2} + _{1}T^{3}$.

5. Suppose that a neutron at rest in free space decays into a proton and an electron. This process would violate
   a)conservation of charge
   b) conservation of energy
   c) conservation of linear momentum
   d) conservation of angular momentum

(1 x 5 = 5)

Section B
Answer any 7 (2 marks each)

6. Explain the spin dependence of nuclear forces between two nucleons.
7. What conclusions can be drawn about nuclear force from the analysis of α-particle scattering and α-particle emission.
8. Reason out the general nature of the nucleon-nucleon potential.
9. Illustrate various processes occurring in heavy-ion reactions.

10. What are Kurie function and Kurie plot?
11. Describe a set up for measuring the neutron scattering cross-section. What is the advantage of using a thin sample of the scatterer?
12. In the semi-empirical mass formula, what is the 'asymmetry energy'?
13. Why it is said that liquid drop model only gives a good account of average behaviour of nucleus.
14. Distinguish between particles and antiparticles.
15. Write the names of fundemental interactions with their relative strength taking strength of strong interaction as 1.

(2 x 7 = 14)

Section C
Answer any 4 (5 marks each)

16. Calculate the repulsive potential energy due to Coloumb interaction among the protons in a nucleus. Using the result explain the stability of the nucleus.
17. The Meson theory of nuclear force assumes the virtual exchange of pions. If a nucleon emits a virtual pion of rest mass 270me, show that the range of nuclear force is 1.43fm.
18. Describe various conservation laws observed in nuclear reactions.
19. Describe schematically a nuclear fission reactor.
20. Give the expected shell-model spin and parity assignments for the ground states of a) ^{7}Li b) ^{11}B c) ^{15}C d) ^{31}P.
21. Name different flavours of quarks, their properties (rest mass, charge and spin).

(5 x 4 = 20)

Section D
Answer any 3 (12 marks each)

22.1. Give the quantum mechanical theory of the deuteron assuming a square well potential. Show that the deuteron is a loosely bound system.

OR

2. What do you understand by nuclear spin and nuclear magnetic moment? Describe a method used for the measurement of magnetic moment of neutron.

23.1. Discuss the energy release in β – decay process? What is meant by the non-conservation of parity in β – decay?

OR

2. Describe the terms nuclear scattering and reaction cross section. Obtain an expression for the reactions cross-section in nuclear scattering.

24.1. Describe the assumptions involved in the single particle shell model. Discuss the results with respect to the angular momentum and parity of the nuclear levels.

OR

2. Discuss from the elementary particle point of view the fundemental interactions in nature. Discuss the different conservation laws to be obeyed by elementary particles.

(12 x 3 = 36)