Reg. No ..... Name **19P4017**

MSc DEGREE END SEMESTER EXAMINATION - MARCH/APRIL 2019

SEMESTER 4 : PHYSICS

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

(For Regular - 2017 Admission and Supplementary - 2016 Admission)

Time : Three Hours Max. Marks: 75

Section A
Answer all the following (1 marks each)

1. Nuclear magneton is smaller than Bhormagneton by a factor about
   (a) 20 (b) 200 (c) 2000 (d) 20000
2. If the nuclear radius of ^{27}Al is 3.6 fm, the approximate nuclear radius of ^{64}Cu in Fermi is
   a) 4.8 b) 3.6 c)2.4 d) 1.2
3. The reaction a + X → Y + b may be expressed as

   a. X(a,b)Y
   b. (X,a) (Y,b)
   c. (X,Y,a,b)
   d. both (a) and (c)

4. For nuclear chain reaction to occur, neutron multiplication factor k should be
   a) 0.4 to 0.8 b) 1 c) more than one d) None of the above.
5. Which one of the following particles does not have a spin ½ ?
   a) Proton b) Neutron c) Photon d) Neutrino.

(1 x 5 = 5)

Section B
Answer any 7 (2 marks each)

6. Briefly describe magnetic moment of the nuclei.
7. Explain the meson exchange theory of nuclear force.
8. Outline two important results obtained concerning p-n scattering at low energies.
9. What do you mean by internal conversion?
10. Define 'isospin' of nucleons.
11. When electron is not an integral part of a nucleus, how do we justify the emission of electrons from nucleui in β-decay.
12. Plot the variation of binding energy per nucleon with mass number.
13. What is pairing residual interaction between two nucleous?
14. Define Baryon number and Lepton number.

15. What are hyperons? Give examples.

(2 x 7 = 14)

Section C
Answer any 4 (5 marks each)

16. Assuming that the nuclear force arises from exchange of mesons, estimate the mass of the meson using Heisenberg's uncertainty relation, if the range of the nuclear force is 1.4 fm.
17. Describe briefly an experiment to determine the nuclear radius and size.
18. A nucleus of mass M emits a gamma ray of energy E_γ. The nucleus was initially at rest. Obtain an expression for recoil energy after emission?
19. For each of the following nuclei, use semi-empirical mass formula to compute the total binding energy and the Coulomb energy: a) ^{21}Ne b) ^{57}Fe.
20. Describe the method of plasma confinement using magnetic bottle.
21. Discuss different types of interactions and their gauge particles.

(5 x 4 = 20)

Section D
Answer any 3 (12 marks each)

22.1. What is nuclear cross section? Describe the partial wave analysis of reaction cross-section for neutron scattering.

OR

2. Give out the theory behind nucleon-nucleon scattering at low energies.

23.1. Discuss in detail the Fermi theory of beta decay. Explain the neutrino hypothesis

OR

2. Explain critically the different physical processes resulting from the interaction of γ-rays with matter and the relative importance of three processes at different energies of radiation.

24.1. Define critical size of nuclear reactor. Explain general aspects of reactor design, describing different types of reactors.

OR

2. Describe the following: i) electroweak theory ii) GUT iii) Quantum chromodynamics

(12 x 3 = 36)