

PG Even Semester (CBCS) Exam., May—2017

PHYSICS

(4th Semester)

Course No. : PHYCC-402

(Nuclear and Particle Physics)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Answer **one** question from each Unit

UNIT—I

1. (a) How the distribution of nucleons in a nucleus is estimated? Describe the variation of nucleon density with distance r from the nuclear centre using a diagram. Express the curve in a mathematical relation explaining different terms. 2+4+2=8

- (b) Derive the expression for orbital magnetic moment of a proton in terms of nuclear magneton. Write the expression for magnetic moment of a nucleon due to spin. What are the experimentally determined values of spin magnetic moment of proton and neutron? 3+1+2=6

2. (a) How can you conclude that nuclear force has a non-central component known as tensor force? Explain this tensor force between two nucleons. 3+2=5
- (b) Name the stable nuclide having highest atomic number Z . Why nuclei having higher atomic numbers are unstable? 1+2=3
- (c) Discuss isospin of nucleus. 6

UNIT—II

3. (a) Fermi gas model treats the structure of nuclei in which form? Name the statistics that is applied to the nucleons in this model. Obtain the expression for Fermi energy of the nucleons assuming N Z . 1+1+5=7
- (b) What are the advantages and disadvantages of Fermi gas model? 3
- (c) Discuss in brief nuclear fission and fusion. 4

(3)

4. (a) Discuss Bethe-Weizsacker mass formula explaining various terms. 8
(b) Using collective model, derive the energy eigenvalues of the rotational states of a nucleus. 6

UNIT—III

5. (a) Derive Fermi's momentum distribution formula for β -decay. 8
(b) Describe Wu's experiment for the detection of parity isolation in β -decay. 6
6. (a) Discuss helicity of neutrino. 2
(b) Are neutrinos Majorana or Dirac particle? Explain the answer by discussing double β -decay. 1+3=4
(c) Find the expression for nuclear scattering cross-section for a beam of nucleons incident on a nucleus. 8

UNIT—IV

7. (a) Write briefly about valence and sea quark constituents of nucleons. 4
(b) What do you mean by strong coupling constant and what is its magnitude? 3
(c) What are the quark constituents of π^+ , π^0 , π^- , ρ^+ , ρ^0 , ρ^- ? 3

(4)

- (d) Explain asymptotic freedom of quarks. What is colour confinement of quarks in hadrons? 4

8. (a) Write some of the properties of muons. How are they produced? 2+2=4
(b) Discuss muon decay scheme. 5
(c) Discuss CPT invariance. 5

UNIT—V

9. (a) Derive the expression for stopping power of a medium when heavy charged particles pass through it. 10
(b) What do you mean by straggling of range? State two reasons for straggling of range of heavy charged particles. 4
10. Describe the construction and working principle of germanium detector. What are the electronic units essentially used in conjunction with semiconductor detector and what are their functions? 8+6=14
