PG Even Semester Examination, May 2025

PHYSICS

(4th Semester)

Course No.: PHY-402

(Nuclear and Particle Physics)

Full Marks: 70

Pass Marks: 28

Time: 3 hours

The figures in the right margin indicate full marks for the question.
Answer any five questions selecting one from each unit.

UNIT-I

1. (a) What do you mean by saturation of nuclear force? How can you conclude that nuclear force has short range? 2+2=4

   (b) Discuss different types of exchange forces arise out of exchange of mesons between nucleons. 6

   (c) Explain the spin dependence of nuclear force. 4

2. (a) Establish that deuteron exists in S and D states. 7

   (b) Describe the experiment for the determination of nucleon density distribution inside nuclei. Describe elaborately how nucleons are distributed inside nuclei. 3+4=7

UNIT-II

3. (a) Describe Ferm's model of atomic nucleus. Mention its advantage and disadvantage. 6+2=8

   (b) Write the similarities and dissimilarities between a nucleus and the drop of a liquid. 4+2=6

4. (a) Write down the magic numbers. Why there numbers are called magic numbers? Assuming a Harmonic Oscillator potential show that shell model can explain few magic numbers. 2+2+5=9

   (b) How the rest of the magic numbers could be explained? 5

UNIT-III

5. (a) Write notes on any three of the following types of nuclear reactions. 3x2=6

   (i) Elastic scattering

   (ii) Disintegration

   (iii) Radiative capture

   (iv) Spallation reactions

   (b) How electric and magnetic radiations originate in a nucleus? Describe in detail how electromagnetic decay process takes place. 2+6=8

6. (a) Explain the helicity of neutrino. Discuss solar neutrino problem. 2+6=8

   (b) Discuss elaborately compound nuclear hypothesis. 6

UNIT-IV

7. (a) Write in brief about valence and sea quark constituents of nucleons. 4

   (b) What do you mean by strong coupling conduct and what is its magnitude? 3

   (c) What are the quark constituents of the following particles? 3

   $\Sigma+$, η, π^0, Ω^-, ψ^-, ω^0

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

8. (a) Write some important properties of muons. How are they produced? 2+2=4

   (b) Write muon decay schemes. 5

   (c) Write notes on 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 is straggling of range? Mention two reasons for straggling of range of heavy charged particles. 4

10. Describe the construction and working of germanium detector. What are the electronic units essentially used in conjunction with semiconductor detector and what are their functions? 8+6=14

*****