

10. (a) Describe the construction and working principle of germanium detector. 8

(b) Explain the functions of the electronic units used in conjunction with semiconductor detectors. 6

PG (CBCS) EVEN SEMESTER EXAMINATION, 2023

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 five questions, taking one from each unit)*

UNIT - I

1. (a) Name the different methods of determining the nuclear size. 2
- (b) Discuss in detail the determination of nuclear size by electron scattering experiment. 10
- (c) Explain whether nuclear force is of short range or long range? 2
2. (a) Describe the experiment that determines the nuclear magnetic moment. 10
- (b) Explain the spin dependency of nuclear force in deuteron. 4

(2)

UNIT - II

3. (a) Define single particle shell model and obtain the magic numbers using harmonic oscillator potential. 11
- (b) What are the disadvantages of this model in explaining the nuclear structure. 3
4. (a) Using collective model, find the energy eigen values of the rotational states of a nucleus. 7
- (b) Describe the vibrational motion of even - even nuclei. 7

UNIT - III

5. (a) Derive Fermi's momentum distribution for β -decay. 9
- (b) Find the selection rules for allowed transitions as well as 1st and 2nd Forbidden transitions in β -decay. 5
6. (a) Discuss an experiment that demonstrate parity violation in β -decay. 9
- (b) Prove that ν_e and $\bar{\nu}_e$ are different particles. 3
- (c) Explain whether neutrinos are Majorana or Dirac particles. 2

(3)

UNIT - IV

7. (a) Allocate the isospin to the strange particles from the following equations: 5
- (i) $\pi^- + p \rightarrow \Lambda^0 + K^0$ (ii) $p + p \rightarrow \Lambda^0 + K^+ + p$
- (iii) $\pi^+ + n \rightarrow \Lambda^0 + K^+$ (iv) $\pi^- + p \rightarrow \Sigma^- + K^+$
- (v) $\pi^+ + p \rightarrow \Sigma^+ + K^+$
- (b) What is the evidence for another quantum number color, under which strong interactions are exactly symmetric? How many colors are there? What data are used to determine this number? 3
- (c) What are the quark constituents of $\Sigma^+, \eta, \pi^0, \Omega^-, \psi^-, \omega^0$ 6
8. (a) How muons are experimentally discovered? 4
- (b) Write briefly the production of muons and their properties. 2+2=4
- (c) Explain muon decay with allowed and prohibited decays. 6

UNIT - V

9. Discuss in detail the principle of operation of scintillation counter along with photo multiplier tube. 14

(Turn Over)