

Exam. Code : 209003

Subject Code : 4883

M.Sc. Physics 3rd Semester (Batch 2020-22)

NUCLEAR PHYSICS

Paper—PHY-504

Time Allowed—3 Hours] [Maximum Marks—100

Note :—Attempt **FIVE** questions in all, selecting at least **ONE** question from each section. The **fifth** question may be attempted from any section. All questions carry equal marks.

SECTION—A

1. (a) Solve the wave equation for ground state of deuteron assuming square well potential. Is there any possibility of existence of the excited states in deuteron ?
(b) Describe the form of tensor force and how does it affect the ground state of deuteron ?
2. (a) Discuss effective range theory to study the nuclear interactions in the case of low energy n-p scattering.
(b) Define Fermi scattering length. What can we deduce from its sign and magnitude ?

SECTION—B

3. (a) What is the limiting value of fissility obtained from Bohr-Wheeler theory of fission? Also, derive expression for critical energy of deformation in case of light and heavy nuclei undergoing spontaneous fission.
- (b) What is spin-parity of the following nuclei?

$$^{25}\text{Mg}, ^{55}\text{Mn}, ^{19}\text{F}$$

4. (a) Write a note on model accounting for the vibration spectra of the nucleus. Which energy states would be formed from the coupling of two quadrupole phonons of same energy?
- (b) Using shell model, how can one determine the nuclear magnetic moments in the form of angular momentum l ? Find the same for ^{39}K , ^{45}Sc .

SECTION—C

5. (a) What are allowed and forbidden beta transitions and what are the criteria to differentiate between these transitions?
- (b) What is the degree of forbiddenness in beta decay of the following nuclear transitions?

$$2^+ \rightarrow 1^+ \quad 2^+ \rightarrow 5^- \quad 3/2^- \rightarrow 9/2^-$$

$$1/2^+ \rightarrow 1/2^- \quad 1/2^+ \rightarrow 3/2^+$$

6. (a) What would be the multipolarity of emitted EM radiation in the following transition?

$$2^+ \rightarrow 1^+ \quad 2^- \rightarrow 0^+ \quad 0^+ \rightarrow 0^+ \quad 3^- \rightarrow 0^+ \\ 9/2^- \rightarrow 7/2^+$$

- (b) Explain the experiment to establish the violation of parity in beta decay.

SECTION—D

7. (a) Explain partial wave method to calculate the scattering cross sections and reaction cross section.
- (b) State and explain Optical theorem.
8. (a) Discuss Breit Wigner formula for nuclear cross sections.
- (b) What would be the cross section in case of interference between resonance and potential elastic scatterings?