

(i) Printed Pages : 3

Roll No.

(ii) Questions : 9

Sub. Code :

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Exam. Code :

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M.Sc. Physics 4th Semester
(2055)

NUCLEAR PHYSICS-II

Paper : PHY-8041

Time Allowed : Three Hours]

[Maximum Marks : 80

Note :— Attempt FIVE questions in all, selecting ONE question each from Units I to IV. Unit-V is compulsory to attempt.

UNIT—I

1. (a) Define Racah coefficients and state its symmetry properties. How it is related to 6-j symbols ? 8
- (b) Prove that the energy shift due to spin -orbit potential in the shell model increases with l -values. 8
2. (a) Calculate the coupled state and corresponding C.G. Coefficients for the two particles with $j = 1$ and $j = 1/2$. 8
- (b) Discuss the shell model based on Harmonic Oscillators Potentials. Also show how Bessel's function can lead to few magic numbers. 8

UNIT—II

3. (a) Define the Rotation matrix and explain how the rotation about an arbitrary axis X can be expressed in terms of Euler angles of rotation. 8
- (b) Write a note on β and γ vibrations in spheroidal nucleus. 8
4. (a) What are nuclear rotational motion ? Derive rotational energy spectra and nuclear wave functions for even-2 nucleus. 8
- (b) Describe the parameterization of nuclear surface. How quadrupole deformation is represented in different co-ordinate systems ? 8

UNIT—III

5. (a) What are stripping and pick-up reactions ? Explain with example. Discuss the relationship between angular momentum transferred in a direct reaction and the angular distribution of the emitted particles. 8
- (b) What is optical model ? What is the basis of optical model used in heavy ion fusion ? 8
6. (a) Derive the Breit-Wigner Dispersion formula. 8
- (b) Explain the statistical theory of nuclear reaction. 8

UNIT—IV

7. (a) Describe Nilsson model of nuclei and its use to explain the nuclear properties. 8
- (b) Explain the phenomenon of Back-bending. 8
8. (a) Explain in detail the Cranking shell model. 8
- (b) Write a note on the production of super heavy elements. 8

UNIT—V

9. (a) Write down the shell model configurations for ${}_{30}\text{Zn}^{67}$ and ${}_{43}\text{Tc}^{99}$.
- (b) What are radioactive ion beams ?
- (c) How Nilsson models differ from shell model ?
- (d) In what situation the statistical model can be used for fusion ?
- (e) What are different types of nuclear reactions ? Explain with examples.
- (f) What do you mean by nuclear halos ?
- (g) What is iso-scalar vibrations ?
- (h) What is Nordheim's Rule ? $8 \times 2 = 16$