

(i) Printed Pages: 3

Roll No.

(ii) Questions : 9

Sub. Code :

3	7	2	4
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Exam. Code :

0	4	7	5
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M.Sc. Physics 4th Semester
(2042)

NUCLEAR PHYSICS-II

Paper : PHY-8044

Time Allowed : Three Hours]

[Maximum Marks : 80

Note :— Attempt **five** questions in all, selecting **one** question each from Units I to IV. Q. No. 9 from Unit-V is compulsory to attempt.

UNIT-I

1. (a) Prove that the energy-shift due to spin-orbit potential in the shell model increases with the ℓ -values. Also discuss the success and failures of this model. 8
- (b) Show that the Bessel's function can lead to a few magic numbers, and write down the shell configuration for ${}_{30}\text{Zn}^{67}$ and ${}_{43}\text{Tc}^{99}$. 8
2. (a) Determine Harmonic oscillator frequency 'w' appropriate to the nuclei ${}^{17}\text{O}$ and ${}^{60}\text{Ni}$. Also write short note on configuration mixing. 8
- (b) Calculate the magnetic moments and quadrupole moments of ${}^{25}\text{Mg}$, ${}^{39}\text{K}$ and ${}^{207}\text{Pb}$ and write the shell configuration for ${}_{20}\text{Ca}^{47}$, ${}_{30}\text{Zn}^{67}$, ${}_{16}\text{S}^{33}$ and predict the ground state spins and parities of these nuclei. -8

UNIT-II

3. (a) Prove that energies of nuclear-vibrational level with one phonon ($\lambda = 3$) is equal to the energy of 2-phonon with ($\lambda = 2$). 8
- (b) Obtain the expression for Clebsch-Gordon (C.G.) series of D-Matrix. 8
4. (a) Derive an expression for the Rotational energy and wave function for the odd $-A$ nucleus. Also discuss the case $K = \Omega \neq 0$ and $K = \Omega = 0$. How Coriolis terms affects the Hamiltonian ? 8
- (b) Describe the various nuclear shapes in the (β, γ) plane. 8

UNIT-III

5. (a) What are the different types of nuclear reactions ? Discuss with examples and what is the difference between compound nucleus and direct reaction ? Give example. 8
- (b) Explain why one needs Statistical Theory for compound nucleus. Discuss Statistical Model for the theory of compound nucleus and derive the evaporation probability and cross-section for specific reactions. 8
6. (a) Explain Briet-Wigner Resonance dispersion formula. 8
- (b) What is Optical Model ? Derive the theoretical cross-section with optical model and compare it with experimental results. 8

UNIT-IV

7. (a) Describe cranking model and give its salient features. 8
(b) Write a short note on super and hyper-deformation. 8
8. (a) Starting from Hamiltonian for an harmonic anisotropic oscillator, develop the Nilsson model and give its salient features. 8
(b) Write a short note on Back-bending phenomenon. 8

UNIT-V

9. (a) Write a short note on nuclear isomerism.
(b) What are giant resonances ?
(c) What is the difference between a rotational and a vibrational nucleus ?
(d) What are super-heavy elements ?
(e) What is Nordheim's rule ?
(f) How Nilsson model differs from Shell model ?
(g) Write a short note on kinematic moment of inertia.
(h) What are stripping and pick-up reactions ? $8 \times 2 = 16$