Exam.Code:0474
Sub. Code: 3718

2021

M.Sc. (Physics), Third Semester

PHY-7003: Nuclear Physics –II

Time allowed: 3 Hours Max. Marks: 60

***NOTE**: Attempt five questions in all, including Question No. IX (Unit-V) which is compulsory and selecting one question each from Unit I - IV.*

x-x-x

UNIT – I

I. a) What are experimental facts in support the shell model? Prove that contribution of spin-orbit potential in the shell model increases with the value of orbital angular momentum 'l'

b) If the nucleus is assumed to be a cubical box of length equal to nuclear diameter, estimate the kinetic energy of the highest energy nucleon of Iron – 56 nucleus. (2x6)

II. a) Show that the Bessel's function can lead to a few magic numbers and determine harmonic oscillator frequency 'w' appropriate to the nuclei ^{17}O, ^{60}Ni.

b) Discuss L-S coupling and j–j coupling schemes. Also write a note on configuration mixing. (2x6)

UNIT – II

III. a) Describe various types of the collective vibrations due to surface and density fluctuations.

b) Derive a relation for Clebsch-Gordan (C.G.) coefficient series for D-matrix. (2x6)

IV. a) Prove that the energies of nuclear vibrational level with one phonon ($\lambda = 3$) is equal to the energy of two phonon with ($\lambda = 2$).

b) Write a short note son Giant resonances and also describe various nuclear shapes in the (β,γ) plane. (2x6)

UNIT – III

V. a) 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 reaction.

P.T.O.

b) What are stripping and pick-up reactions? Discuss the relationship between angular momentum transferred in direct reactions and the angular distribution of the emitted particles. (2x6)

VI. a) What is difference between compound nucleus and direct reaction? Give two example in each case. Explain Briet-Wigner Resonance dispersion formula.

b) What is optical model? Explain. (2x6)

UNIT – IV

VII. a) Explain the features of Nilsson model and obtain deformed Hamiltonian for the same.

b) Write and explain in detail the phenomenon of back bending. (2x6)

VIII. a) What is cranking model? Compare this model with Nilsson.

b) What are uses of Routhian plots? Write a note on the production of super heavy elements. (2x6)

UNIT – V

IX. a) Explain Northernism's rule.

b) Define seniority quantum number

c) What is ISO-Scalar vibrations?

d) How C.G. coefficient is related to Wigner 3-j symbols?

e) What do you mean by nuclear Halos?

f) How Nilsson model differ from Shell model? (6x2)

x-x-x