

Reg. No.

--	--	--	--	--	--	--	--	--	--



PHH 453

Second Semester M.Sc. Degree Examination, September/October 2022

PHYSICS

Nuclear and Radiation Physics

Time : 3 Hours

Max. Marks : 70

Note : Answer **any four** questions, choosing **one** each from Part – I to IV and **two** questions from Part – V.

PART – I

1. a) Discuss basic properties of the nucleus. Explain how nuclear charge radius is estimated using high energy electron scattering method.
b) Explain how the protons and neutrons contribute to the total magnetic dipole moment of the nucleus. **(10+5)**
2. a) Discuss Gamow theory of alpha decay and explain why alpha particles are emitted from heavy nuclei rather than the emission of a proton or a neutron.
b) Explain the selection rule for various allowed and forbidden types of beta decay. How is it reflected in Fermi theory ? **(8+7)**

PART – II

3. a) Give a brief account of energy loss of gamma rays in matter and explain how the energy loss depends on energy of the photons.
b) Give an account of gamma ray attenuation in matter and obtain the expressions for linear and mass absorption coefficients. **(8+7)**
4. a) Sketch the characteristic curve of a typical gas detector and explain the functioning of each region.
b) Explain the importance of exposure rate, absorbed dose and equivalent dose. **(9+6)**

PART – III

5. a) Explain the common method for production of radioisotopes.
b) Discuss various radiation shielding materials. What are the criteria for selecting proper shielding ? **(8+7)**

P.T.O.



6. a) What are the features of single particle shell model ? How does this model help in determining the magic numbers ?
 b) Explain any two applications of radioisotopes. (9+6)

PART – IV

7. a) What is nuclear reaction cross section ? Discuss how it is calculated theoretically measured experimentally.
 b) What is threshold energy of a nuclear reaction ? Obtain an expression for threshold energy of a endoergic nuclear reaction. (7+8)
8. a) Explain the functioning of a typical fission reactor. What are the factors determining the criticality of the reactor ?
 b) Give an account of a breeder reactor and its functioning.
 c) Write a note on nuclear fuel cycle. (6+5+4)

PART – V

9. Answer **any two** of the following : (2×5=10)
- a) Explain the relevance of Kurie plot and $t_{1/2}$ values in beta decay.
 b) If a gamma ray of energy 662 keV is Compton scattered at an angle of 90° , calculate the energy of scattered electron (Rest mass energy of electron is 511 keV).
 c) In a given family of isobars with $A = 197$, estimate the nuclear charge of the most stable isobar.
 d) Calculate the energy released per second due to alpha disintegration of 1 g of Ra-226 ($Q_\alpha = 4.88$ MeV).
-