Exam.Code:0474
Sub. Code: 3716

2012

M. Sc. (Physics) Third Semester

PHY-8031: Nuclear Physics - I

Time allowed: 3 Hours Max. Marks: 60

NOTE: *Attempt five questions in all, including Question No. 9 (Unit-V) which is compulsory and selecting one question each from Unit I-IV. Use of calculator is allowed.*

x-x-x

Unit I

1. (i) What is the significance of electric quadrupole moment? Do all nuclei have quadrupole moment? List some ways to measure the same.
   (ii) Discuss the different reaction mechanisms (RM); a) Compound nucleus RM, b) Pre-equilibrium RM. (6,6)

2. (i) Calculate the distance of closest approach of a 2MeV deuteron to a Lead nucleus? Compare this distance for a neutron of same energy.
   (ii) What do you understand by Q-value of a reaction? What information does it give about a reaction? Obtain an expression for Q-value. (6,6)

Unit II

3. (i) Discuss Fermi theory of beta decay and hence obtain the angular correlation coefficient.
   (ii) What is electron capture? Which radiations are emitted as a consequence of electron capture? (8,4)

4. (i) Discuss Gamow's theory of alpha-decay.
   (ii) Calculate the maximum energy available to electrons in β^- decay of ^{24}Na. Why beta particles of such energies are not observed experimentally? (8,4)

Unit III

5. (i) Deutron is a bound state of proton and neutron with total J =1. It is known to be a mixture of s-state and d-state. Why a p-state or g-state does not contribute?
   (ii) Obtain an expression for differential elastic cross section of protons by protons. (3,9)

6. (i) Discuss various types of exchange forces in nuclei? Why such forces are proposed?
   (ii) Differentiate between coherent and incoherent scattering.
   (iii) What features of nuclear force are learnt from deuteron properties? (4,4,4)

P.T.O.

Unit IV

7. (i) Obtain a condition for spontaneous fission.
   (ii) Discuss a method for slow neutron detection.
   (iii) Calculate the number of fissions per second in a 100 MW reactor. (4,4,4)

8. (i) Define critical energy of a fissionable nucleus.
   (ii) Calculate the maximum activity induced in a 100 mg copper foil exposed to a thermal neutron flux density of 10^{12} /cm^2 sec.
   (iii) What do you understand by neutron diffusion? (3,6,3)

Unit V

9. (i) What is a Bragg Curve ?
   (ii) What is difference between charge and matter distribution of a nucleus?
   (iii) Define helicity. What is the helicity of a neutrino?
   (iv) What is the significance of scattering length?
   (v) List the types of nuclear reactors.
   (vi) Why nuclei have magnetic dipole moments? (2 each)

x-x-x