Dr. SP

Reg. No										

प्रज्ञानं ब्रह्म

Manipal

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DEPARTMENT OF SCIENCE, MANIPAL UNIVERSITY, MANIPAL

Make UP

SECOND SEMESTER M. Sc. (PHYSICS)
END SEMESTER EXAMINATION, MAY, 2016
SUBJECT: NUCLEAR AND PARTICLE PHYSICS; PHY-608

Time: 3 Hrs. **Max. Marks: 50**

Note: (i) Answer Any Five of the following questions. (ii) Any missing data may suitably be assumed.

1. (a) What are the advantages of electron scattering to determine the nuclear radius?
   (b) With the help of a neat diagram, explain Hofstadter's Electron scattering Experiment to determine the radius of the nucleus. [4+6 =10]
2. Describe the principle of scintillation phenomena. Draw the diagram of a gamma-ray spectrometer and explain its working. [4+6 =10]
3. (a) Estimate the depth of the nuclear potential well using Fermi gas model of the nucleus.
   (b) Using shell model find ground state spin and parities. (i) $_8O^{15}$, (ii) $_8O^{17}$ [6+4=10]
4. Derive an expression for Q-value of a nuclear reaction in the lab system. How it is related to the threshold energy of an endoergic nuclear reaction. [10]
5. (a) Give the classification of elementary particles based on their spins.
   (b) Explain 'Associated production' with example. [6 +4=10]
6. (a) Given that the range of interaction is 1fm. Estimate the rest mass of the exchange particle between the nucleons. Express your answer in terms of the rest mas of the electron.
   (b) A Nucleus with mass number A = 235, splits into two nuclei whose mass numbers are in the ratio 2:1.Find the radii of the new nuclei. Given $R_0 = 1.4$ fm
   (c) Calculate the Fermi Energy of protons and neutrons in $_{82}Pb^{208}$
   (d) The $B^{10}(\alpha,p)C^{13}$ reaction shows among others a resonance for an excitation energy of 13.23 MeV of the compound nucleus. The width of this level is found to be 130 keV. Calculate the mean life of the nucleus for this excitation. [3+2 +3+2 =10]

General Data:

(i) Avogadro's Number = 6.023×10^{23} (g-mole)$^{-1}$

(ii) Planck's Constant (h) = 6.63×10^{-34} Js

(iii) Boltzmann's Constant (k) = 1.38×10^{-23} JK^{-1}

(iv) Permittivity of free space (ε_0) = 8.85×10^{-12} Fm^{-1}

(v) Charge on an electron (e) = 1.6×10^{-19} C

(vi) Electron mass = 9.11×10^{-31} kg = 5.4858×10^{-4} u = 0.511 MeV / c^2

(vii) Proton mass = 1.6726×10^{-27} kg = 1.0072765 u = 938.280 MeV / c^2

(viii) Neutron mass = 1.6749×10^{-27} kg = 1.008665 u = 939.573 MeV / c^2

(ix) 1 year = 3.156×10^7 s

(x) Speed of light in vacuum (c) = 3×10^8 ms^{-1}

(xi) 1 unified mass unit (u) = 931.5 MeV / c^2