Dr. SP

Reg. No										

प्रज्ञानं ब्रह्म

Manipal

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DEPARTMENT OF SCIENCE, MANIPAL UNIVERSITY, MANIPAL

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) Discuss the salient features of *beta ray spectra* and explain how *Pauli's hypothesis of neutrino* emission solved the anomalies in the beta ray spectra. State the properties of neutrino.
   (b) Write a note on Fermi-Curie plot. (7+3=10)
2. (a) Give Yukawa's Meson theory of nuclear force. Explain how it explains the anomalous magnetic moment of the nucleons
   (b) The meson theory of nuclear forces assumes the virtual exchange of pions. If a nucleon emits a virtual pion of rest mass 270 m_e, calculate the range of the nuclear force. (7+3=10)
3. (a) Considering Neutrons and protons of the nucleus as independent, fully degenerate Fermi gas, obtain the expression for the Fermi Energy of protons and neutrons.
   (b) Calculate the Fermi Energy of protons and neutrons in $_{92}U^{238}$ (7+3=10)
4. (a) With a neat schematic sketch, describe the working of a GM counter. What do you' mean by the terms – Dead time, Recovery time, paralysis Time, Quenching, threshold voltage and operating voltage.
   (b) Calculate the electric field generated at a point, 1 cm, from the anode in a gas filled detector with an operating voltage of 2000V. Given-inner radius 2 cms, anode wire diameter 0.008 cm and gas pressure 1 atm. (7+3=10)
5. List the twelve types of photon interactions with matter. Briefly explain (i) Photoelectric effect, (ii) Compton -effect and (iii) pair production. (10 marks)
6. (a) Explain with examples the conservation of Isospin and strangeness in elementary particle interactions.
   (b) Give an account of quark model of baryons.

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