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SARDAR PATEL UNIVERSITY

M. Sc. (Physics) (IVth Semester) Examination

Day: Saturday, Date: 22/10/2016, Time: 02:00 p.m. to 05:00 p.m.

Course No. PS04CPHY01 (Nuclear and Particle Physics)

CBCS (choice based credit system)

Important Note: Signs have their usual meaning.

Q.1: Eight multiple choice questions (MCQ) carry one mark each.

Q.2: Short answer questions carrying two marks each (attempt any seven out of nine).

Q.3 to Q.6: Long answer questions carrying 12 marks each.

Total Marks: 70

Q1 (i) The following constituent does not contribute to the magnetic moment of deuteron.

(a) orbital motion of neutron (b) orbital motion of proton

(c) intrinsic spin of individual nucleon (d) all of them

(ii) The single particle shell model is primarily based on one of the following parameter;

(a) magic number (b) chemical potential

(c) kinetic energy (d) total energy

(iii) A free neutron outside a nucleus undergoes a _____ - decay.

(a) β^- (b) β^+ (c) Electron - capture (d) None of them

(iv) The leptonic number for nucleons is _____

(a) 0 (b) 1 (c) -1 (d) 2

(v) In Electron Synchrotron, the electrons are accelerated by _____.

(a) radio-frequency (b) Electro-magnet (c) Electric field (d) Permanent magnet

(vi) The Synchrotron radiation power varies as _____ of radius of the particle motion.

(a) -2 (b) 1 (c) 0 (d) 2

(vii) The gauge bosons responsible for the strong interaction are known as.

(a) gluons (b)gravitons (c) neutrinos (d) mesons

(viii) In slowing down of neutron, when a fast neutron collides elastically with a nucleus of mass number A, loses nearly _____ of its initial energy, taking mass of neutron as unity.

(a) A^{-1} (b) A (c) A^{-2} (d) A^2

Q2 (i) By shell model explain islands of isomerism.

(ii) Discuss how the binding energy of deuteron is determined?

(iii) Discuss in short Q-values in the three β-decay processes.

(iv) Giving examples explain the new law of conservation discussed in Fermi theory of β-decay.

(v) Using schematic diagram of a tank containing hydrogeneous material, explain experimental detection of neutrino.

(vi) Explain the nature of nuclear force and argue that the nuclear force is basically a non-central force.

(P.T.O.)

(1)

(vii) Explain why fusion of light nuclei and fission of heavy nuclei releases energy?

(viii) Discuss the medical diagnostic and therapeutic applications of nuclear physics.

(ix) Explain briefly the idea of grand unification theory.

Q3 (a) In case of deuteron, discuss that the probability of finding the neutron and proton beyond the range of nuclear force is more than twice that of finding them within the range of nuclear force. 6

(b) Solve the Schrodinger equation for deuteron in a square well potential. 6

OR

(b) In the collective nuclear model discuss vibration of spherical nuclei. 6

Q4 (a) Discuss by deriving equation for the energy loss of heavy charged particle interacting in matter. 6

(b) Discuss the different types of alpha particle spectra. How these spectra are analyzed based on the nuclear energy levels and what is Geiger-Nuttel law. 6

OR

(b) Explain Fermi theory of β - decay by deriving and discussing the equation of transition probability. 6

Q5 (a) Discuss the classification of modern charged particles accelerators. 6

(b) Discuss nucleosynthesis in stars. 6

OR

(b) Estimate the rate of neutrino production during PPI cycle inside the Sun. Discuss the neutrino puzzle and explain how it is resolved? 6

Q6 (a) Prepare a classification of elementary particles in terms of the underlying fundamental interaction forces. 6

(b) Discuss the antiproton detection experiment. 6

OR

(b) Discuss Gell-Mann's SU(3) Quark Model. Explain its successes and failures. How is it improved? 6

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