SARDAR PATEL UNIVERSITY

M Sc (Physics)- IV Semester Examination
PS04CPHY01 Nuclear and Particle Physics
Day and Date: Tuesday, 23 October 2018

Time: 2:00 to 5:00pm   Max marks: 70

I   Choose the best possible answer from the choices given below the questions
                                                              (8x1=8)

1.   Gluons are related to

    (a) QFD   (b) QCD   (c) QED   (d) QFT

2.   The pair of nuclei ^3_1H, ^3_2He are called

    (a) Isomers   (b) Isotopes   (c) Isobars   (d) Mirror nuclei

3.   The quadrupole moment for a closed shell nuclei will be

    (a) Positive   (b) Negative   (c) Zero   (d) ±1

4.   The life time of a free proton is as long as the life time of the Universe. It is
    attributed to

    (a) Baryon number conservation   (b) Energy- momentum conservation
    (c) Parity conservation   (d) Lepton number conservation

5.   According to the single particle shell model, the spin parity of $^{17}_8O$ is

    (a) 2^+ (b) $1/2^+$ (c) $5/2^+$ (d) $3/2^-$

6.   The parity of a magnetic multipole transition is

    (a) $(-1)^{l+1}$ (b) $(-1)^l$ (c) $(-1)^{2l}$ (d) -1

7.. Spontaneous symmetry breaking in the standard model is manifested through

    (a) CPT theorem   (b) Existence of Higg's field
    (c) CP Violation   (d) E8 symmetry

8,   Quarks composition of the Λ_C baryon is

    (a) uds   (b) udc
    (c) dsc   (d) usc

II   Attempt any seven of the following short answer questions.   (7x2=14)
    1.   Explain the basic nature of nuclear exchange forces.
    2.   What does the experimental non zero quadrupole moment of deuteron suggest?
        Explain briefly

(1)   (PTO)

3. Discuss the liquid drop model of nuclei. Explain its successes and failures.
4. Discuss Geiger-Nuttal law with reference to the alpha decay
5. Explain CPT theorem.
6. Explain the selection rules for beta transitions?
7. Explain Lawson criterion.
8. Explain the basic idea of the grand unification theory?
9. With the help of extended Gell-Mann - Nishijima formula find the electric charge of a charm quark in units of $|e|$.

III A Considering a 3 dimensional square well for the study of the binding energy of deuteron bound system as a two body system and show that deuteron is a loosely bound state. (6)

B With the help of harmonic oscillator potential and spin-orbit potential explain the shell model and draw the nuclear shell structure for protons and neutrons. Using it determine the ground state spin – parity of $^{13}_{6}C$. (6)

OR

B. Discuss the basic features of the nuclear collective model. Explain the rotational and vibrational nuclear energy bands. (6)

IV A. Discuss the Gamow's theory of alpha decay using quantum tunneling. (6)

B. Describe the Fermi theory of beta decay. (6)

OR

B. Explain Gamma decay and explain the multipole transition probabilities. Discuss the respective selection rules. (6)

V A. Discuss interaction of heavy charge particle with matter. Get an expression for the energy loss of heavy charge particle in matter. (6)

B. Discuss the nuclear reaction kinematics and derive an expression for the Q value of a nuclear reaction. (6)

OR

B. Discuss the medical applications of nuclear physics. (6)

VIA. Discuss how the elementary particles are classified. Discuss various conservation laws abide by the elementary particles. (6)

B. Give a summary of the standard model of particle physics. (6)

OR

B. Explain the gauge principle and show how it is implemented in QED as an example of U(1) gauge theory. (6)

X

2