Roll No. | | | | | | | | | | | | |

Total No. of Pages : 02

Total No. of Questions : 11

PIT M.Sc (Physics) (Sem.-3)

PARTICLE PHYSICS

Subject Code : PHS-533

Paper ID : [51122]

Time : 3 Hrs. Max. Marks : 70

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains SEVEN questions carrying FIVE marks each and students have to attempt any SIX questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Answer briefly :

a. What is the theory of strong interactions?

b. Draw the baryon octet of $J^P = 3/2^+$ multiplet of SU (3) gauge group.

c. What is Grand unification theory (GUT) and how it is associated with SU (5) gauge group?

d. What are the fundamental interactions of standard model?

e. What is the reason to introduce the color degree of freedom?

f. Discuss the fundamental particles of standard model.

g. Pion is a triplet under SU(2). Comment.

h. What are the self-conjugate particles?

i. Gluons are the exchanging bosons in strong interaction having color charges.

j. Discuss strangeness, hypercharge and isopin in context of electric charge.

SECTION-B

2. Show that negative energies are simply associated with the destruction operators acting on positive energy particles to reduce the energy within the system.

3. Explain why the simple quark model faced difficulties in explaining few existing states and how an extra degree of freedom has helped it to overcome these difficulties.

4. A 1 MeV positron encounters a 1MeV electron travelling exactly in opposite direction. What are the wavelengths of photons produced? (Given the rest mass of electron or positron=0.5112MeV).

5. Explain the non-conservation of CP (charge conjugation and parity) in the decay process of neutral kaon.

6. Discuss CPT invariance. Take one example to discuss CPT invariance in the same.

7. Explain five major conservation laws used in particle physics. Give the values of the quantum number associated with these laws for the $\Xi^-, \Sigma^+, \Lambda^0, \Omega$, and ρ particles.

8. Explain the method used by Wu and Shaknov to prove that fermions and anti- fermions have the opposite parity.

SECTION-C

9. How can you justify lepton universality? Discuss the experiment which demonstrated for the first time the interaction of antineutrino produced in β-decays of the fission products in a nuclear reactor.

10. Describe with a table the particle content of the standard model of particle physics. Show how the particles can be divided into bosons and fermions, and indicate how some particles appear in generations.

11. Using general relativistic mass energy conservation term between energy(E), momentum(P), and mass(m), derive the Dirac wave equation for free particle in the covariant form.