UNIVERSITY OF THE PUNJAB

Seventh Semester – 2019

Examination: B.S. 4 Years Program

Roll No. in Fig. .....

Roll No. in Words. .....

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Signature of Supdt.:

PAPER: Particle Physics-II **MAX. TIME: 15 Min.**

Course Code: PHY-408 Part–I (Compulsory) **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.
Please encircle the correct option. Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer, cutting and overwriting is not allowed. (1x10=10)

1) Klein-Gordon equation describes the particle which is moving relativistically with spin
   (a) ½
   (b) Zero
   (c) 1
   (d) none of these

2) Fermi Golden rule is described by the relation
   (a) $W_{fi}=2\pi|V_{fi}|\rho(E_i)$
   (b) $W_{fi}=2\pi|V_{fi}|^2\rho(E_i)$
   (c) $W_{fi}=2\pi|V_{fi}|\rho(E_i)$
   (d) none of these

3) Scalar product of two four vector is defined as
   (a) $A.B=A^oB^o-A.B$
   (b) $A.B=A^oB^o+A.B$
   (c) $A.B=A.B-A^oB^o$
   (d) none of these

4) **The expression for the current density J obtained from the Klein-Gordon equation of spin zero particle represented by state ϕ**
   (a) $i(\phi^*\nabla\phi-\phi\nabla\phi^*)$
   (b) $-i(\phi^*\nabla\phi-\phi\nabla\phi^*)$
   (c) $-i(\phi\nabla\phi^*\phi^*\nabla\phi)$
   (d) none of these

5) **One example of Lorentz invariant quantity is**
   (a) relativistic mass
   (b) probability density
   (c) length of four vector
   (d) relative velocity

6) **The time dependent Schrödinger equation for a particle is**
   (a) Lorentz invariant but non relativistic
   (b) relativistic but non invariant
   (c) non relativistic and non invariant under Lorentz transformation
   (d) relativistic

7) **The result of following anti-commutation relation $\{\gamma^\mu, \gamma^\nu\}$ is**
   (a) 0
   (b) 1
   (c) $2g^{\mu\nu}$
   (d) δ^μ_ν

8) **The Dirac equation is**
   (a) 1st order differential
   (b) 2nd order differential
   (c) Non relativistic
   (d) Non linear

9) **In Dirac equation all alphas are**
   (a) Identity
   (b) Traceless
   (c) Non traceless
   (d) Inverse of other

10) **$\psi^\dagger\gamma^0\gamma^\mu\psi$ represents**
   (a) four vector current
   (b) Dirac matrices
   (c) probability density
   (d) Adjoint spinor

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Seventh Semester – 2019

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Roll No. .....

PAPER: Particle Physics-II

Course Code: PHY-408 Part – II

MAX. TIME: 2 Hrs. 45 Min.

MAX. MARKS: 50

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

Q2. Attempt all questions

i. Define Projection Operators P_R and P_L in terms of Chirality operator. Also show that $P_R P_L = 0$

(4)

ii. Derive Klein Gordon equation from relativistic energy momentum relation.

(4)

iii. Define Dirac γ matrices. Show that $\{\gamma^\mu, \gamma^\nu\} = 2g^{\mu\nu}$

(4)

iv. What is Dirac hole theory. Explain.

(4)

v. Define Dirac bilinears. Write down the expressions of scalar, vector, tensor in terms of solutions of Dirac equation.

(4)

Section II

Q3. Derive adjoint form of Dirac equation. Write down the matrix form of α and β matrices. Also derive continuity equation of Dirac equation and show that the probability density for Dirac equation is positive definite.

(10)

Q4. Discuss the large and small components of Dirac spinors in detail.

(10)

Q5. Why is Schrodinger wave equation is not an acceptable relativistic wave equation? Check the :orentz invariance of Schrodinger equation. Why is Klein Gordon equation rejected?

(10)