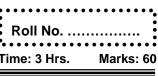
UNIVERSITY OF THE PUNJAB B.S. 4 Years Program : Seventh Semester – Fall 2021

Paper: Particle Physics-II

Course Code: PHY-408

- Fall 2021 •..... Time: 3 Hrs.



## Q.1. Give short answers of the following:

- 1. Show that  $\gamma^{\mu}\gamma^{\nu} + \gamma^{\nu}\gamma^{\mu} = 2g^{\mu\nu}$
- 2. Show that  $\beta^2 = 1$
- 3. Why do we need relativistic wave equation?
- 4. Show that  $g^{\mu\nu}g_{\mu\nu} = 4$
- 5. Show that  $\gamma^0$  is hermitian and  $\gamma^k$  is anti hermitian, where k = 1, 2, 3
- 6. Show that  $c^2t^2 x^2$  remains invariant under Lorentz transformation,
- 7. Show that  $(\sigma . p)^2 = |p|^2$
- 8. How does Dirac theory explains the negative energy solutions?
- 9. Define Chirality and Helicity operators.
- 10. Derive Klein-Gordon equation from relativistic energy momentum relation.

## Answers the following questions.

(3x10=30)

Question 2. Derive adjoint form of Dirac equation. Write down the matrix form of  $\alpha$  and  $\beta$  matrices. Also derive continuity equation for Dirac equation and show that probability density is positive definite.

Question3. Discuss large and small components of Dirac Spinor in detail.

Question 4. Show that  $\bar{\Psi}\sigma^{\mu\nu}\Psi$  behaves as a tensor quantity.