

## Homework 4 (10 points)

1. (20 Points) Obtain Dirac Equation in the standard way - by taking the square root of the relativistic hamiltonian. Express the Dirac equation in relativistically invariant form. Obtain also the anticommutation relations between  $\gamma^\mu$  matrices. Find the solution of the Dirac equation for free electrons.

2. Obtain the expression for the Lagrange density of leptonic field with mass  $m$ . Show that its Lagrange - Euler equation reproduces Dirac Equation. Optional (10 points) Obtain also Dirac equation for positrons.

3 Using Noether theorem, check what conservation law follows from the global phase invariance of the Lagrange density of the leptonic field with mass  $m$ .

4. If Dirac spinors are normalized such as:  $\bar{u} u = 2m$ , show that in this case

the following sum rule takes place 
$$\sum_{s=-1/2}^{1/2} u \bar{u} = \not{p} \gamma^0 + m$$