PHY 5667 : Quantum Field Theory A, Fall 2007

September 20^{th}, 2007
Assignment # 4
(due Thursday October 4^{th}, 2007)

1. Study the invariance of the Dirac Lagrangian

$$\mathcal{L} = \bar{\psi}(i\gamma^\mu\partial_\mu - m)\psi$$

under the action of the following two global transformations:

1.a) $\psi \to \psi' = e^{i\alpha}\psi$ and $\bar{\psi} \to \bar{\psi}' = e^{-i\alpha}\bar{\psi}$;

1.b) $\psi \to \psi' = e^{i\alpha\gamma^5}\psi$ and $\bar{\psi} \to \bar{\psi}' = \bar{\psi}e^{i\alpha\gamma^5}$.

Show that **1.b)** is a symmetry of $\mathcal{L}$ only when $m = 0$. In each case derive the corresponding Noether current, check that it has zero four-divergence and canculate the associated conserved charge.

2. Problem 3.6 of Peskin and Schroeder's book.

3. Read Section 3.6 of Peskin and Schroeder's book and derive the results summarized in the table on page 71.

4. **No credit** (i.e. do it for your own interest, even at a later time): Problem 3.4 of Peskin and Schroeder's book.