PHY 5669: Quantum Field Theory B, Spring 2010

April 23^{rd}, 2010

Final Exam

(due Friday 30^{th}, 2010)

1. The interaction Lagrangian between leptons and weak gauge bosons in the Standard Model is given in Eq. (88.23) of Srednicki's book. Make sure you understand the form of that Lagrangian, derive the Feynman rules for the interaction vertices between leptons and weak gauge bosons, and use them to calculate the decay rates for $W^+ \to e^+\nu_e$, $Z^0 \to e^+e^-$, $Z^0 \to \bar{\nu}_e\nu_e$. Neglect the electron mass. Express your results in GeV. (**Note**: polarizations of massive vector bosons are discussed in detail in Section 85).

2. The interaction Lagrangian between quarks and weak gauge bosons in the Standard Model is given in Eq. (89.21) of Srednicki's book, when the $J^{\pm\mu}$ are expressed in terms of mass eigenstates and written as in Eqs. (89.30) and (89.31). Make sure you understand the form of that Lagrangian, derive the Feynman rules for the interaction vertices between quarks and weak gauge bosons, and use them to calculate the decay rates for $W^+ \to u\bar{d}$, $Z^0 \to u\bar{u}$, $Z^0 \to \bar{d}d$ (**note**: consider only the first generation of quarks, and set $\theta_2 = \theta_3 = 0$ in Eq. (89.32)). Neglect the quark masses. Express your results in GeV.