Spring, 2011. Homework Set 4. Due Tues, May 24.

- 1. Verify, in SU(5) that the combination $\overline{5} + 10$ is free of anomalies. You may want to do this by considering subgroups.
- 2. Verify that an adjoint field of the form

$$\Phi = v \operatorname{diag}(2, 2, 2, -3, -3)$$

minimizes the potential for the adjoint, and determine v, if

$$V(\Phi) = -\mu^2 \operatorname{Tr} \Phi^2 + \frac{\lambda}{2} (\operatorname{Tr} \Phi^2)^2.$$

To do this, you must first show that there is a stationary point of this form, and then consider the curvature about this point (i.e. the masses of the excitations).

3. Compute the coupling constant unification, i.e. the mass where the SU(2) and SU(3) couplings unify, starting with their values at M_Z ; from which compute the U(1) coupling at low energies.