

# Homework 6 (June 2, 2004)

## Problem 1: Mixing of 4-quark operators

Compute the mixing matrix  $Z_{ij}$  for the operators  $O_1$  and  $O_2$  containing four different quark fields. Use the color and Dirac Fierz relations given in class and recycle results we had obtained for the one-loop renormalization of QED.

## Problem 2: Non-leptonic b quark decays & penguin transitions

(a) Write down all possible decays of a b quark into u, d, s and c quarks. Order the various decay modes into the following three classes:

- Class I: only current-current operators contribute
- Class II: current-current and penguin operators contribute
- Class III: only penguin operators contribute

(b) Determine the parametric size of the various operators (take into account matching conditions and CKM factors).