3/12/07 Homework 4. Due March 19

1. For $\lambda\phi^4$, we have $m_B^2 = Z_m m_R^2$ (check your lecture notes for the notation). Define $Z_m \equiv 1 + \sum_k c_k(\lambda)\epsilon^{-k}$. To two loops, i.e. to order $\hat{\lambda}^2$, where $\hat{\lambda} \equiv \lambda/16\pi^2$, one computes

$$Z_m = 1 + \epsilon^{-1}(\hat{\lambda} - \frac{5}{12}\hat{\lambda}^2) + \epsilon^{-2}2\hat{\lambda}^2$$

Verify that the coefficient c_2 of the $1/\epsilon^2$ term is completely determined by c_1 and the condition that γ_m have a smooth $\epsilon \to 0$ limit. Verify that the c_1 and c_2 given above satisfy this relation (using the expression given in class for $\beta(\lambda, \epsilon)$ to one loop).

2. Peskin 7.3.

3. Peskin 12.1.