Physics 722, Spring 2007
Problem Set 2: Scalar Self Energy, due Tuesday, Feb 12.

1. *Scalar Self Energy*

Consider the theory of a real scalar field coupled to a Dirac spinor field,

$$\mathcal{L} = \frac{1}{2}(\partial_\mu\phi)^2 - \frac{\mu^2}{2}\phi^2 + \overline{\psi}(i\partial\!\!\!/ - m)\psi - ig\,\overline{\psi}\gamma^5\psi\phi - \frac{g_3}{3!}\,\phi^3 - \frac{g_4}{4!}\,\phi^4 + \text{counterterms.}$$

Calculate the one-loop renormalized self energy $\widetilde{\Pi}(k^2)$ for the scalar field ϕ. $\widetilde{\Pi}(k^2)$ should satisfy the renormalization conditions $\widetilde{\Pi}(\mu^2) = 0$ and $d\widetilde{\Pi}/dk^2|_{k^2=\mu^2} = 0$. Your result should be left in terms of integrals over a single Feynman parameter.