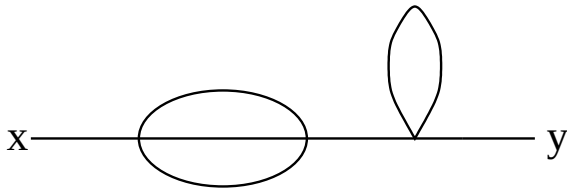
PHY 5667 : Quantum Field Theory A, Fall 2005

October 20^{th}, 2005

Assignment # 4

(due Thursday November 3^{rd}, 2005)

1. The following Feynman diagram:



represents a contribution to $\langle\Omega|T\{\phi(x)\phi(y)\}|\Omega\rangle$. Explain from which term of the perturbative expansion of $\langle\Omega|T\{\phi(x)\phi(y)\}|\Omega\rangle$ does it come from and write the corresponding analytical contribution both in position-space and in momentum-space.

2. Summarize the logical steps that, starting from the generalization of Eq. (4.31) of your book to the case of four scalar fields (i.e. four point correlation function), allows you to write Eq. (4.58). You do not have to go over all the details, just explain why at $\mathcal{O}(\lambda^2)$ the four point correlation function $\langle\Omega|T\{\phi(x_1)\phi(x_2)\phi(x_3)\phi(x_4)\}|\Omega\rangle$ corresponds to the series of diagrams written in Eq. (4.58) and show how can you find them.

3. Which of the diagrams in Eq. (4.58) contribute to the invariant matrix element $\mathcal{M}(p_1, p_2 \to p_3, p_4)$ at $\mathcal{O}(\lambda^2)$? Write the explicit expression of $\mathcal{M}(p_1, p_2 \to p_3, p_4)$ at $\mathcal{O}(\lambda^2)$ in momentum space.

4. Problem 4.2 of Peskin and Schroeder's book.