

QFT II (Kreimer, Summer 2014)

Exercise I (April 16 2014, to be handed in April 28 2014)

Let $L_B := \frac{1}{2}\partial_\mu\Phi(x)\partial^\mu\Phi(x)$ and $L_F := +\bar{\Psi}(x)\not{\partial}\Psi(x)$.

1.(40 Points)

Determine the dimensions d_i for which the following Lagrangians L_i are renormalizable.

- $L_1 := L_B + g\Phi^3(x)$.
- $L_2 := L_B + g\Phi^4(x)$.
- $L_3 := L_F + (\bar{\Psi}(x)\Psi(x))^2$.
- $L_4 := L_B + g\Phi^6(x)$.
- $L_5 := L_F + L_B + g\Phi(x)\bar{\Psi}(x)\Psi(x)$.

2.(40 Points)

Find the 1PI one-loop vertex graphs Γ_i for each of these Lagrangians L_i and show that they are overall logarithmically divergent for UV powercounting.