1. What are the momentum space Feynman rules for QED?

2. Consider the theory from problem 3 of homework #3:

\[ \mathcal{L} = \mathcal{L}_0 + \mathcal{L}_{int} \]

\[ \mathcal{L}_0 = \partial_\mu \phi^* \partial^\mu \phi - m^2 \phi^* \phi + \sum_{i=1}^{2} \bar{\psi}_i (\partial - m_i) \psi_i \]

\[ \mathcal{L}_{int} = -g (\phi \bar{\psi}_1 \psi_2 + h.c.) - \frac{\lambda}{4!} (\phi^* \phi)^2 \]

Calculate the renormalization $Z$ factors for this theory. Use dimensional regularization with minimal subtraction. Work to order $\lambda$ and order $g^2$.

3. In quantum electrodynamics, calculate the renormalization constant $Z_e$ using dimensional regularization with minimal subtraction.

4. Argue that for an integral of the form

\[ \int \frac{d^n k}{(2\pi)^n} k^\alpha k^\beta k^\mu k^\nu f(k^2) \]

you can make the replacement

\[ k^\alpha k^\beta k^\mu k^\nu \rightarrow \frac{1}{n(n+2)} [g^{\alpha\beta}g_{\mu\nu} + g^{\alpha\mu}g_{\beta\nu} + g^{\alpha\nu}g_{\beta\mu}] (k^2)^2 \]

in the integrand.