# QFT II (Kreimer, Summer 2014)

**Exercise III** (May 28 2014, to be handed in June 11 2014)

1.(10 points)
In $\phi_4^4$ theory, determine all graphs contributing to the self-energy up to two loops and determine their symmetry factors.

2.(10 points)
Determine their renormalized integrands in parametric renormalization. Use renormalization conditions such that the self-energy $\Sigma(q^2, m^2)$ vanishes at $q^2 = m^2$, and its derivative wrt $q^2$ as well: $\Sigma'(q^2, m^2)_{q^2=m^2} = 0$.

3.(10 points)
Introduce $Z$-factors into each monomial in the Lagrangian. Determine them to one-loop order for the two monomials quadratic in the fields using either dimensional regularization or a cut-off $c$ in parametric renormalization so as to fulfill the above renormalization conditions.