## **<u>Exercise 8</u>**: Loop expansion for the $\phi^3$ -theory

The action for the  $\phi^3$ -theory in *d*-dimensions is given by

$$S = \int d^{d}r \left[ \frac{1}{2} \left( \nabla \phi \right)^{2} + \frac{1}{2} m_{0}^{2} \phi^{2} + \frac{\lambda}{3!} \phi^{3} \right]$$
(1)

(10 points)

- i) Find the critical dimension of the theory.
- ii) Specify the relevant vertex functions to deal with the critical properties.
- iii) Find all diagrams that contribute to the relevant vertex functions up to two loop order.
- iv) Write down the explicit expression for the diagrams contributing to the relevant vertex functions up to one loop order.