Quantum field theory I	**Exercise sheet 7**

Green's functions, normal ordering

Exercise 1:

(a) Consider the definition

$$(2\pi)^4\delta^{(4)}(p_1+...+p_n)\tilde{G}^{(n)}_{T,\mathsf{c}}(p_1,...,p_n) \\ \equiv \int \mathrm{d}^4x_1 ... \int \mathrm{d}^4x_n \, G^{(n)}_{T,\mathsf{c}}(x_1,...,x_n)e^{i(p_1\cdot x_1+...+p_n\cdot x_n)} \, .$$

Which property of $G^{(n)}_{T,\mathsf{c}}$ guarantees the existence of the Dirac-δ in front of $\tilde{G}^{(n)}_{T,\mathsf{c}}$?

(b) The Green's function $G^{(n)}_T$ can also contain disconnected parts, i.e. $G^{(n)}_T = ... + G^{(m_1)}_T G^{(m_2)}_T$, with $m_1+m_2=n$. How do such parts manifest themselves in $\tilde{G}^{(n)}_T$?

Exercise 2:

(a) Verify explicitly the validity of

$$:\hat{\phi}_I(x_1)\hat{\phi}_I(x_2): \, = \, :\hat{\phi}_I(x_2)\hat{\phi}_I(x_1): \, .$$

(b) Generalize the result to show that field operators can be commuted with each other within normal ordering, i.e.

$$:...\hat{\phi}_I(x_i)...\hat{\phi}_I(x_j)...: \, = \, :...\hat{\phi}_I(x_j)...\hat{\phi}_I(x_i)...: \, .$$