

## Homework 5

Show that

$$\exp \left[ \frac{i}{2} \int \frac{\tilde{j}_a^*(p) \tilde{j}^a(p)}{p^2 - i\epsilon} \frac{d^4p}{(2\pi)^4} \right] = \exp \left[ \frac{i}{2} \int j(x)^a \Delta_{ab}(x - x') j^b(x') d^4x d^4x' \right] \quad (1)$$

in which

$$\Delta_{ab}(x - x') = \int e^{ip(x-x')} \frac{\eta_{ab}}{p^2 - i\epsilon} \frac{d^4p}{(2\pi)^4} \quad (2)$$

and we relate the electromagnetic field to its Fourier transform by

$$A_b(x) = \int e^{ipx} \tilde{A}_b(p) \frac{d^4p}{(2\pi)^4} = \int e^{-ipx} \tilde{A}_b^*(p) \frac{d^4p}{(2\pi)^4} \quad (3)$$

and also relate the conserved current to its Fourier transform as

$$j_b(x) = \int e^{ipx} \tilde{j}_b(p) \frac{d^4p}{(2\pi)^4}. \quad (4)$$

This short homework is due on 24 x 2012.