Quantum Field Theory	**Exercises No. 10**

[Wednesday 15. June 2010, 12:30-14:00 in D5-153]

Exercise 10.1: Suppose we can write the quadratic part of the action as follows,

$$S_E^{(2)} = \int_{P,Q} \eth(P+Q)\, \frac{1}{2} \tilde{A}^a_\mu(P) \tilde{A}^a_\nu(Q) \tilde{\Delta}^{-1}_{\mu\nu}(P)$$

where we use the notation from exercise 5.4. The Fourier transfor of the two-point function is then called propagator $\Delta_{\mu\nu}(P)$

$$\langle \tilde{A}^a_\mu(P) \tilde{A}^b_\nu(Q) \rangle = \delta^{ab}\, \eth(P+Q)\, \tilde{\Delta}_{\mu\nu}(P) \;.$$

Confirm that the propagator $D_{\mu\nu} = \Delta_{\mu\nu}(P)$ given for a parameter dependent gauge fixing in lecture is indeed the inverse of

$$\tilde{\Delta}^{-1}_{\mu\nu}(P) = -P^2 \delta_{\mu\nu} + \left(1 - \frac{1}{\alpha}\right) P_\mu P_\nu \;.$$

Exercise 10.2: Compute the propagator $\langle 0 | T\{A_\mu(x), A_\nu(y)\} | 0 \rangle$ in Lorentz gauge.

Exercise 10.3: Derive the quadratic part of the action in Fourier space for $SU(N)$ in axial gauge and check that the propagator is then given by

$$\Delta_{\mu\nu}(P) = -\frac{1}{4k^2} \left[g_{\mu\nu} + \frac{(t^2 + \xi k^2) k_\mu k_\nu}{(k \cdot t)^2} - \frac{k_\mu t_\nu + t_\mu k_\nu}{k \cdot t} \right]$$

Exercise 10.4: Please check the symmetrised forms of the 3- and 4-point vertices given in lecture.