Quantum Field Theory	**Exercises No. 13**	07.07.2016

[Tutor: Marc Sangel, Tutorial: Wednesday 13. Juli 2016, 16:00-17:30 in V2-200]

Exercise 13.1:

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

$$S_E^{(2)} = \int \frac{d^4P}{(2\pi)^2} \int \frac{d^4Q}{(2\pi)^2} \delta^{(4)}(P+Q)\, \frac{1}{2} \tilde{A}^a_\mu(P)\tilde{A}^a_\nu(Q)\Delta^{-1}_{\mu\nu}(P) \; .$$

The Fourier transform of the two-point function is then called propagator $\Delta_{\mu\nu}(P)$

$$\langle \tilde{A}^a_\mu(P)\tilde{A}^b_\nu(Q)\rangle = \delta^{ab}\,\delta^{(4)}(P+Q)\,\Delta_{\mu\nu}(P) \; .$$

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

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

Exercise 13.2:

Starting from the definition $[T^a, T^b] = i f^{abc} T^c$, show that the following holds:

(a) Jacobi-identity [Einstein summation convention]

$$f^{abe}f^{cde} + f^{cae}f^{bde} + f^{bce}f^{ade} = 0 \; .$$

b) The adjoint matrix representation of the generators $(T^b)_{ac} = i f^{abc}$ satisfies the commutation relation above.

Exercise 13.3:

Please derive the symmetrised forms of the 3- and 4-point vertices given in lecture (pages 89-90).