Problem Set 1

1) Evaluate the following Greens functions for a free Fermi gas. Take the average$<>$with respect to a state characterized by a distribution function $< a_p{}^+ a_p >= n_p$

Evaluate the Fourier Transform in space and time of the following Greens functions.

a) $G^t(1,2) = -i < T(\psi(x_1 t_1)\psi^\dagger(x_2 t_2)) >$

b) $G^{\tilde{t}}(1,2) = -i < \tilde{T}(\psi(x_1 t_1)\psi^\dagger(x_2 t_2)) >$

c) $G^>(1,2) = -i < \psi(x_1 t_1)\psi^\dagger(x_2 t_2) >$

d) $G^<(1,2) = i < \psi^\dagger(x_2 t_2)\psi(x_1 t_1) >$

e) $G^K(1,2) = -i < [\psi(x_1 t_1), \psi^\dagger(x_2 t_2)] >$

f) $G^R(1,2) = -i\theta(t_1 - t_2) < \{\psi(x_1 t_1)\psi^\dagger(x_2 t_2)\} >$

g) $G^A(1,2) = i\theta(t_2 - t_1) < \{\psi(x_1 t_1), \psi^\dagger(x_2 t_2)\} >$

Compare them with the Fourrier transfomr of the Matsubara Greens function. $g(\tau, x) = - < T(\psi(\tau, x)\psi^\dagger(0,0)) >$.