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

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 Fourier transform of the Matsubara Greens function. $g(\tau, x) = - < T(\psi(\tau, x) \psi^\dagger(0, 0)) >$. 