

Physics 221A

Quantum Field Theory

Fall 2007

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Course web page: <http://www.kitp.ucsb.edu/~joep/Web221A/221A.html>

ASSIGNMENT #7

Due: Friday, Nov. 16, 5pm in TA's mailbox (5th floor Broida). See course web page for late homework policy.

1. Srednicki 16.1

2. Repeat the previous calculation using the MS-bar scheme to define λ . Show that the $m^2 \rightarrow 0$ limit diverges in 16.1, but not in MS-bar. The general statement is that off-shell correlators, with all external momenta spacelike, have a smooth $m^2 \rightarrow 0$ limit in MS-bar.

3. Srednicki 18.1. Hint: the four-fermion interaction should come out dimensionless in $d = 2$. There are several interesting models in this class (Thirring, Gross-Neveu).

4. For the previous problem, determine the degree of divergence of a general graph with scalars and Dirac fermions as we did in class, by counting the integrations and propagators. Verify your previous conclusions about renormalizability. (Hint: because the kinetic term has only one derivative, the propagator has only one power of momentum in the denominator.)

5. Consider an interaction $g\phi^2\partial_\mu\phi\partial^\mu\phi$. When is it renormalizable? What is the dimension of g in $d = 4$? If one expands the action for gravity as a fluctuation around flat spacetime, this is the form of the graviton self-interaction (except that there are more indices).