UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Department of Physics

Physics 221A **Quantum Field Theory** **Fall 2012**

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ASSIGNMENT #7
Due: Weds., Nov. 14, 5pm in graders' mailbox.

1. Srednicki 18.1. Add part (e): In $d = 2$ spacetime dimensions, which of these interactions are allowed in a renormalizable theory?

2. In the theory 22.10 with two real scalar fields, calculate to leading order (λ^0) the vacuum expectation value

$$\langle 0|\mathrm{T}\, j^\mu(x)\phi_1(x_1)\phi_2(x_2)|0\rangle\,,$$

where the current j^μ is given in 22.16. Verify the Ward identity.

3. In the theory 22.10, calculate

$$\langle 0|\mathrm{T}\, \phi_a(x_1)\phi_b(x_2)|0\rangle\,,$$

to order λ^0. Calculate

$$\langle 0|\mathrm{T}\, \phi_a(x_1)\phi_b(x_2)\phi_c(x_3)\phi_d(x_4)|0\rangle\,,$$

to order λ^0 and λ^1.

The purpose of this problem is to get you used to fields with indices. There are two ways to approach this: taking explicit values $1, 2$ for the indices and considering all possibilities, or working directly with the abstract index notation a, b. The second one is ultimately more useful, but you might also try the first if you get confused.

By the way, you don't need to consider the propagator loop and counterterm, these cancel as in problem 14.5.