corrections to the midterm exam

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November 13, 2009

Important. Parts C and E of problem 4 are deleted from the exam. Part C is very complicated and involves a tricky combination of things we discussed, but in retrospect I should have laid the basis for this in either lecture or problem sets before asking it on an exam.

If you have managed to solve 4C, or make significant progress, include your results for these parts in the exam you turn in. You may get some additional credit in the course. But the exam grade will be based only on the other questions.

I apologize for putting you all through what might have been a stressful time with this problem.

1. The 'x' in the Hamiltonian should be 'q'.

2. In each of the three parts, 'it' refers to the moment mentioned in the previous sentence. Thus, for example, in i, the last sentence should say: "Express the zeroth moment of $\hat{C}(\omega)$ as an equilibrium average of something, and find its value."

In part iii, delete the part of the question that asks for the value of the second moment. Thus the middle sentence should say: "Express the second moment of $\hat{C}(\omega)$ as an equilibrium average of something."

Hint: if you have trouble with this question, come back to it after doing problem 3.

4. You should assume that the eigenstates are normalized.

$$\langle\phi_0|\phi_0\rangle = 1 \qquad \langle\phi_1|\phi_1\rangle = 1$$

The coefficients $c_0(t)$ and $c_1(t)$ in the equation for ψ on p. 5 have nothing to do with the functions defined on p. 9. On p. 5, change them to $d_0(t)$ and $d_1(t)$ to avoid confusion.

4C. Part 4C is deleted from the exam. See above.

Some suggestions: Note that the Hamiltonian given here is the Hamiltonian only for the two level system degree of freedom. It is not the total Hamiltonian for two level system plus its surroundings. This Hamiltonian has an explicit time dependence, since the $h_1(t)$ and $h_2(t)$ are functions of t, with statistical properties that are discussed on pp. 8 and 9.

When you solve this problem, you have to take into account the fact that the Hamiltonian has an explicit time dependence. If you use the Schrodinger formulation, you will need to solve the time dependent Schrodinger equation. If you use the Heisenberg formulation, you will need to take into account the time dependence of the Hamiltonian in your calculation of the time dependence of the Heisenberg operators.

If you decide to use the Heisenberg representation, you will find lecture notes N13 helpful in dealing with the time dependent Hamiltonian. Or use some other source of information, but don't guess, because it is not likely that you are familiar enough with the Heisenberg representation to remember how to do such problems.

It is also possible to use the Schrodinger representation to solve the problem. However, the correlation functions as we have defined them have Heisenberg operators in their definition, and you would have to translate the definitions into the Schrodinger representation first.

4E. Part 4E is deleted from the exam. See above.