Physics 8.321, Fall 2002
Homework #12

Due **Wednesday, December 11** by 4:30 PM in the 8.321 homework box in 4-339B.

1. Sakurai: Problem 4, Chapter 5 (page 346)

2. Sakurai: Problem 7, Chapter 5 (page 347)

3. Sakurai: Problem 11, Chapter 5 (page 348)

4. Sakurai: Problem 12, Chapter 5 (page 348)

5. Sakurai: Problem 14, Chapter 5 (page 349)

6. Consider the Hamiltonian for a 1D quantum system ($m = \hbar = \omega = 1$)

$$\frac{1}{2}p^2 + \frac{1}{2}x^2 + \frac{\lambda}{4}x^4 .$$

(a) Use one of the methods used to solve problem 5(a) to find an accurate approximation to the ground state energy for the values $\lambda = 0.01, \lambda = 0.1, \lambda = 1$.

(b) Use time-independent perturbation theory to approximate the ground state energy for each value of λ in (a). Plot the approximation in each case as a function of the order n in perturbation theory. Can you find the order in perturbation theory at which the approximation is best for the cases $\lambda = 0.1, \lambda = 1$?

(c) Use the method of Pade approximants to compute $P_n^n(\lambda)$ for at least $n = 1, 2$. How close can you come to the exact answer for $\lambda = 1$?