Physics 7501 (Quantum Mechanics I): Homework Set No. 7

Due date: Tuesday, October 27, 2015, 5:00pm in PRB M2025 (Abhishek Mohapatra's office)

Total point value of set: 100 points

Problem 1 (10 pts.): Exercise 5.2.1 (Shankar, p. 163)

Problem 2 (20 pts.): Exercise 5.2.2 (Shankar, p. 163). *Hint:* I found it useful to replace the potential $V(x)$ by a suitable Gaussian potential of smaller magnitude in order to put an upper bound on the energy expectation value.

Problem 3 (10 pts.): Exercise 5.3.1 (Shankar, p. 166)

Problem 4 (10 pts.): Exercise 5.3.4 (Shankar, p. 167)

Problem 5 (20 pts.): Exercise 5.4.2 (Shankar, p. 175)

Problem 6 (15 pts.): Exercise 5.4.3 (Shankar, p. 175)

Problem 7 (15 pts.):
(a) (5 pts.) According to Postulate II, the angular momentum operator is defined as $\hat{\vec{L}} = \hat{\vec{X}} \times \hat{\vec{P}}$. Is this operator Hermitean? If not, write down a Hermitean expression for the angular momentum.
(b) (10 pts.) Using Ehrenfest's theorem, derive the equation of motion for the expectation value of angular momentum in an arbitrary state $|\psi\rangle$ for a particle in a 3-dimensional harmonic oscillator potential (with Hamiltonian given by Eq. (4.3.4) in Shankar).