Tutorial 4

T4.1 For the ground state of one dimensional Harmonic oscillator, compute the quantities Δx and Δp_x, and show that the uncertainty principle is obeyed.

T4.2 Show that parity operator is linear and Hermitian.

T4.3 Imagine in a spectroscopic experiment, when the integral $\emptyset = \int \Psi_{v1}(x) x \Psi_{v2}(x) dx$ is non-zero (here $\Psi_{v1}(x)$ and $\Psi_{v2}(x)$ are harmonic oscillator wavefunctions), the transition between the states $\Psi_{v1}(x)$ and $\Psi_{v2}(x)$ are allowed and the transition is forbidden when $\emptyset$ is zero. Predict the types of transitions observed in this experiment using Parity.

T4.4 An operator $\hat{A}$ is called anti-Hermitian operator if $\int \Psi_m^* \hat{A} \Psi_n d\tau = -\int \Psi_n \left(\hat{A}\Psi_m\right)^* d\tau$. Prove that eigenvalues of anti-Hermitian operators are purely imaginary.