

Jashore University of Science and Technology
Department of Physics
Bachelor of Science with Honours in Physics
1st semester of 3rd year, Academic session: 2022–2023
Course no.: PHY 3103 **Course title: Quantum Mechanics I**
Class test no.: 03 **Date: March 02, 2024**

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1. For a quantum harmonic calculate $[\hat{a}^\dagger, \hat{p}]$. [4]

2. For a quantum harmonic calculate $\hat{a}^\dagger \hat{a} \hat{a}^\dagger \psi_3$. [4]

3. What is the energy of a quantum harmonic oscillator at the 3rd excited state? [3]

4. Why is the position expectation value for a quantum harmonic oscillator zero? [3]

5. For a quantum harmonic calculate $\langle \hat{x}^2 \rangle_{\psi_n}$. [6]