S.G.T.B. Khalsa College

B.Sc.(Hons.) Physics   **Quantum Mechanics (2022-23)**   Due Date and Time :
32221501   **Lab Assignment # 6**   24.08.2022, 11:59PM
Teacher: Mamta   **Harmonic Oscillator - II**   Max. Marks   : 20

1. (15 marks) **Programming**

   (a) Write a Python code to solve the Schrödinger Equation for an electron (in dimensionless form) subjected to the harmonic oscillator potential using based on the Numerov algorithm with the bisecting shooting method as discussed in the Lab class held on August 12, 2022. The code should

      i. The code should obtain the first six energy eigenvalues e_n for an electron subjected to harmonic potential.

      ii. print the eigen values obtained along with the analytical values in tabulated form

      iii. plot e_n as a function of n and determine the slope and intercept

   (b) Extend your program to plot e_n as a function of n^2, fit a linear curve, find slope and and compare its value with the actual value.

   (c) Extend your program to

      i. obtain the first five normalised eigenfunctions (dimensionless form) and corresponding probability densities in the range $[-x_{max} : x_{max}]$ with $x_{max} = 10$.

      ii. plot these normalised wavefunctions along with the corresponding analytical solutions.

      iii. plot the probability densities along with the analytical ones

   (d) Repeat for $x_{max} = 5$ and $x_{max} = 50$..

2. (5 marks) **Discussion**
   Interpret and discuss your results.