B.Sc.(Hons.) Physics
32221501
Teacher: Mamta

S.G.T.B. Khalsa College
Quantum Mechanics (2022-23)
Lab Assignment # 7
Harmonic Oscillator - III (matching)

Due Date and Time :
08.09.2022, 11:59PM
Max. Marks : 20

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1. (7 marks) **Theory**

   (a) Explain why correct asymptotic solutions are not obtained when you integrate the Schrödinger Equation from x_{min} to x_{max}.

   (b) Discuss how the instability discussed above may be controlled by matching the solution at a point in the allowed region.

2. (10 marks) **Programming**

   (a) Modify the program in assignment 6 to determine the energy eigenvalues and eigenfunctions with correct asmptotic behaviour for an electron subjected to the harmonic oscillator potential. The code should

      i. Determine the left and right wavefunctions by integrating forward from $x = 0$ to $x = x_{cl}$ and backward from $x = x_{max}$ to $x = x_{cl}$, x_{cl} being the right classical turning point. The code should obtain the first six energy eigenvalues e_n for an electron subjected to harmonic potential.

      ii. match the left and right wavefunctions and the derivatives

      iii. print numerical and analytical energy eigenvalues (in units of $\hbar\omega$) in tabulated form for the ground state and first five excited states.

      iv. Print the values of the wavefunction and its derivative at $x = x_{cl}$.

   (b) Repeat for $x_{\max} = 2$ and $x_{\max} = 10$..

3. (3 marks) **Discussion**
   Interpret and discuss your results.