Experiment- 4
Integration Using SCILAB Built-in-Functions & Gauss Legendre Quadrature Method

1. At $t = 0$ a particle of unit mass is at rest at the origin.If it is acted upon by a force $\vec{F} = 100te^{-2t}\hat{i}$, determine both analytically and computationally, the change in momentum of the particle in going from $t = 1$ to $t = 2$. Also, plot the velocity of the particle as a function of time in steps of 0.1s. What would be the velocity after a long time has elapsed? **(Use intg( ))**

2. **FRESNEL INTEGRALS** are defined as
   $C(\omega) = \int_0^\omega cos(\frac{\pi q^2}{2})dq$
   $S(\omega) = \int_0^\omega sin(\frac{\pi q^2}{2})dq$
   have applications in analysis of Fresnel diffraction patterns.

   (a) Compute the integrals **(Use integrate( ))** for ω lying between 0 and 5 in step size of 0.1 and display your results as

ω	$C(\omega)$	$S(\omega)$

   (b) Verify the following properties of Fresnel Integrals taking 3 different values of $\omega = 2, 4, 7$.
      i. $C(-\omega) = -C(\omega)$
      ii. $S(-\omega) = -S(\omega)$

   (c) Verify the following properties of Fresnel Integrals.
      i. $C(-\infty) = S(-\infty) = \frac{-1}{2}$
      ii. $C(\infty) = S(\infty) = \frac{1}{2}$

   (d) Plot $y = S(\omega)$ & $x = C(\omega)$ for ω lying between -5 to +5 in step size of 0.1.

3. Write a SCILAB code to obtain an estimate of the integral
   $I = \int_0^2 \frac{e^x sinx}{1+x^2}dx$
   using the five-point Gauss-Legendre Quadrature formula.

4. Employ **two-** through **six-**point Gauss-Legendre formulae to solve
   $I = \int_{-3}^3 \frac{1}{1+x^2}dx.$
   Interpret your results in light of **truncation error** in the given approximation.

5. Using the SCILAB built-in functions **inttrap( )** & **intsplin( )** compute the distance travelled for the following data .

t(min)	1	2	3	4	5	6	7	8	9	10
v($m\ s^{-1}$)	5	6	5.5	7	8.5	8	6	7	7	5

6. A rod of length L has a non-uniform density.λ, the mass per unit length of the rod varies as $\lambda = \lambda_o(\frac{x^2}{L})$, where λ_o is a constant and x is the distance from the lighter end of the rod. If $L = 6,\ \lambda_o = 0.5$, compute the Centre of Mass of the rod.