EE6506 Computational Electromagnetics: Jan - May 2021, Uday Khankhoje
Assignment 2, released 26 Feb, due 12 March 2021.

1. According to the Gauss quadrature rule, an integral is expressed as a weighted sum of n terms in the form: $\int_a^b f(x)dx \approx \sum_{i=1}^{n} w_i f(x_i)$, where $w_i, w_2, \cdots w_n$ are unknown coefficients known as weights and $x_1, x_2 \cdots x_n$ are the discretization points. Construct a Gauss quadrature rule and use it to evaluate the following integral: $\int_1^4 \frac{e^x}{\sqrt{x^2}} dx$. In addition:

   (a) Plot the function in the interval [0.1 - 4.9].

   (b) Show the development of the quadrature rule, noting that the limits asked above are non-standard. Bonus points if you derive the nodes and weights using symbolic math in MATLAB.

   (c) Study the accuracy of your rule as a function of the number of quadrature points, while comparing your output with the *integral* command in MATLAB for the same evaluation.

2. A thin metallic cylinder of length L and radius a, along the $y-axis$ as shown in the figure. The electrostatic potential on the cylinder is given as 1V. Using point matching and expressing the surface charge density ρ_s in terms of a line charge density ρ_l, in turn expressed via a pulse basis expansion:

$$\rho_l = \sum_{n=1}^{N} a_n g_n(y), \quad \rho_l = 2\pi a \rho_s,$$

   solve the following:

   (a) find and plot the surface charge density on the cylinder ρ_s,

   (b) plot the potential V over the surface of the sphere with radius 10m.

   Assume cylinder length $L = 1m$, and radius $a = 0.01m$. It is recommended to at least use a 3-point Gauss-quadrature rule to evaluate the integrals. Bonus points if you can justify the choice of the number of quadrature points; also if you can re-use some code from Q1 here.