ME 261 **Exam #2** **Fall 2020**

Name (Print) ________________________________

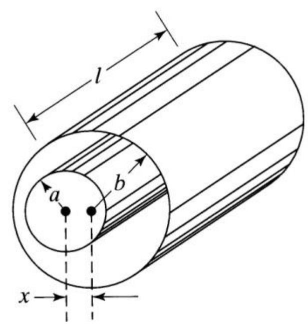
Instructions:

1. The first line of your program should contain your first and last name.
2. You are required to type the honor code "**On my honor as a student, I have neither given or received aid on this exam**" and type your name at the beginning of the MSWord or PDF file of your solution.
3. The output of the problems should be given in a MSWord or a PDF file. The plot of Problem 2 should also be given in the same MSWord or PDF file.
4. Upload FOUR m-files (each problem has a main program and a function program) and ONE MSWord or a PDF file

---

Problem 1

A neutrino horn is basically a coaxial transmission line constructed of air filled concentric conducting cylinders or cones. Axial electric current flows on the inner diameter of the outer conductor. The front end is short circuited which enables the outside of the inner conductor to carry the return current in the opposite direction. When the cylindrical axis of the inner and outer conductors are not coincident, see figure, the result is an unbalanced force on the inner conductor.



Due to rapid pulsing of the neutrino horn this flexural force could produce an oscillation about the equilibrium position. This vibration, if of significant magnitude, could render the device dynamically unstable. It has been found that the forces that produce the dynamic instability are proportional to the capacitance of the two eccentric cylinders. The capacitance, ***C***, is given by the equation:

$$C = \frac{2\pi\varepsilon l}{cosh^{-1}\left(\frac{a^2+b^2-x^2}{2ab}\right)}$$

where ε = permittivity of the medium (water), a and b = radii of the cylinders, *l* = length of the cylinders, and x = eccentricity. **The function corresponding to $\cosh^{-1}$() is acosh() in MATLAB.**

What is the eccentricity, x, corresponding to a capacitance equal to 1.5×10^{-9} F. given that $\varepsilon = 71 \times 10^{-11}$ F/m, *l* = 0.25 m, a = 0.12295 m and b = 0.3 m.

Requirements:

---

1. Write down the equation you are going to solve in the form f(x,a,b,ε,*l*) = 0 in the MSWord or the pdf file.
2. Write a main program and a function program.
3. Use the **False-Position Method** to solve this problem.
4. The **False-Position Method** must be written as a function program with appropriate inputs and outputs.
5. In your main program
   a. define all constants
   b. define the equation you are solving as a function handle
   c. define an es corresponding to 5 significant figures
   d. define the lower and upper values as xl = 0.05 and xu = 0.15.
   e. output the result to 5 significant figures

```
The eccentricity is: #.##### m
It took # iterations to converge.
```

Problem 2

Determine the **FIRST positive root** of the equation below using the Newton-Raphson Method.

$$f(x) = -4 + 3x - \frac{1}{2}x^2$$

Requirements:

1. Must use a main/driver program and a function program
   a. The main/driver program is used to
      i. define initial guess or guesses needed. These should be hardwired into your program (in other words no input statements). To define the initial guess, you are required to plot function f(x) over a range of x, and save the plot in the MSWord or PDF file.
      ii. define function handle for ***f(x)***,
      iii. define function handle for ***f '(x)***,
      iv. define es for 5 significant figures
   b. The function program is the code for the Newton-Raphson Method.
2. Output should be as follows:

```
The first positive root of f(x) is: #.####
It took # iterations to converge!
```