

INDIAN INSTITUTE OF TECHNOLOGY MADRAS
Department of Chemical Engineering

CH 2082
Assignment 5 (03/04/2014)

1. Attempt all problems on your own.
2. You may discuss with the TAs for assistance.
3. All variables should be declared or initialized within your program
4. **Comment all your files**
5. Name each program using the following convention using a combination of your roll number, assignment number and question number. i.e., if your roll number is CH12B001, name the program in the first question of the first assignment as follows:
CH12B001_A1_Q1.m
6. Submit a single zipped folder containing .m files for each of the questions and a single pdf file that is published. The zip file should be named as follows: if your roll number is CH12B001, then the zip file name would be CH12B001_A1

Note: All submissions are to be made by 5pm on the same day.

1. The friction factor f depends on the Reynolds number for turbulent flow in a smooth pipe according to the following relationship:

$$\frac{1}{\sqrt{f}} = -0.4 + \sqrt{3} \ln(\text{Re} \sqrt{f})$$

The above equation may be rearranged to be written in the standard forms: $f = G(f)$ or $F(f) = 0$. With $f^{\text{initial}} = 0.01$, find the friction factor for $\text{Re} = 10^5$, use Newton Raphson to solve for f .

2. Minimize the function $y = \frac{1}{4}x^4 - x^3 + x^2 + 2$. Use `fminunc`.

3. A golf ball of mass 46 gm, radius of 21 mm is propelled into the air with an initial speed of 35.5 m/s making an angle with the ground. Assume the ground is perfectly flat and neglecting air resistance, determine the range (horizontal distance travelled) of the ball. The ball experiences drag friction, the magnitude of which is approximately given by the following formula:

$$F_{\text{drag}} = 0.5 \rho r^2 v^2$$

where ρ is the density of air, and v is the instantaneous speed of the ball. Assume $\rho = 1.3 \text{ kg/m}^3$. In each of the above cases, determine the angle such that horizontal range is maximized. (Hint: Write a function that takes in the angle of launch and returns the range that is calculated using an ode solver. Use this function in `fminuncon`)