INDIAN INSTITUTE OF TECHNOLOGY MADRAS
Department of Chemical Engineering

CH 2082
Assignment 2

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 usinsg 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

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1. The position of a pendulum undergoing steady oscillation about a mean position at time t can be described by the following equation:

$$x = A\sin(\frac{2\pi t}{T} + \phi),$$

where x is the position, A is the amplitude of oscillation, T is the time period of oscillation and φ is the phase angle. In this particular instance, T = 1. A stroboscope is used to measure the position and the readings are tabulated in Table 1. Estimate A and φ. *Hint: Use least squares and the following*
formula:

$$\sin(C + D) = \sin(C)\cos(D) + \cos(C)\sin(D)$$

Table 1: Oscillating pendulum

Time, t	Position, x
0	1.7651
0.2	1.5034
0.4	-0.7990
0.6	-1.9720
0.8	-0.3891
1.0	1.7684

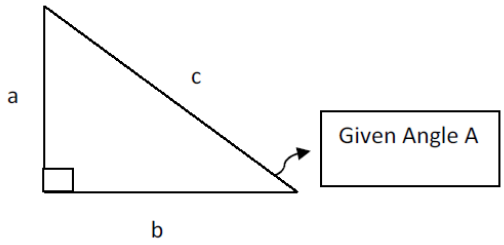
2. In an experiment, yield z is dependent on two reactants x and y (in mole percentage). The compound yields at 10 data points are given in the Table 3. The chemist proposes the following model

Table 3: Yield data

Yield z	Reactant x	Reactant y
73	20	10
78	20	10
85	30	15
90	40	22
91	40	22
87	50	27
86	50	27
91	50	27
75	60	32
65	70	40

to explain the yield z as a function of the reactant concentrations x; y
$z = a_0 + a_1x + a_2x^2 + b_1y + b_2y^2$. Estimate the parameters a_0; a_1; a_2; b_1; b_2

3. In a right triangle, write a **function** that returns the lengths of both the opposite and the adjacent sides, when given the hypotenuse and the angle. The user should be able to input the hypotenuse and angle A.



4. Create an m-file to establish the below matrix for a user inputted “n”.

$$\begin{bmatrix} n & n-1 & n-2 & \cdots & 0 \\ n+1 & n & n-1 & \cdots & 1 \\ n+2 & n+1 & n & \cdots & 2 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 2n & 2n-1 & 2n-2 & \cdots & n \end{bmatrix}_{(n+1)\times(n+1)}$$

Write a function in MATLAB to count the number of elements that have the magnitude strictly greater than a user defined input (some real value).

5. Write a matlab(.m) file to plot r (radius) of a hyperbola with a = 4 and b = 7 as θ goes from 0 to π. Also plot the value of θ ranging 0 to π.

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$