

INDIAN INSTITUTE OF TECHNOLOGY MADRAS

Department of Chemical Engineering

Simulation lab (CH2082)

Assignment 1 – (05/03/2014)

Instructions

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. 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

QUESTIONS

1. The vapour pressure of acetonitrile as a function of temperature is given by the following equation: $\ln(P_{\text{sat}}) = 14.2724 - 2945.47/(T + 224)$, where \ln is the natural logarithm, P_{sat} is the vapour pressure in kPa, and T is the temperature in C.
 - a. Write a MATLAB program to compute the vapour pressures of acetonitrile in the temperature range from 50-100 C, at intervals of 5 C.
 - b. Write a program that determines the saturation temperature in K for the following pressures: 60, 65, 70, 75, 80 kPa.
2. For the following matrix, find out
 - a. Determinant
 - b. Inverse of the matrix
 - b. Eigen values
 - c. Rank of the matrix

$$A = \begin{bmatrix} -1.2953 & 0.0568 & 0.4407 \\ -0.1935 & -0.4862 & 0.1072 \\ -0.5079 & 0.0363 & -0.2185 \end{bmatrix}$$

3. Write a MATLAB program to find the sum of squares of the first 100 natural numbers
 - a. using 'for' loop
 - b. without using 'for' loop
4. Make a panel of figure with four subplots. In one of these, plot $x^2+y^2=25$; in the second, plot $y = 5x+3$; in the third, plot $y = x^2$; in the fourth, plot $y = 3\cos(4x+2)$. Plot these functions for x values between [-5, 5] taking an interval of 0.05.

Do necessary formatting.

5. Pure A is fed to an ideal CSTR where an irreversible first order reaction $A \rightarrow B$ takes place. The inlet flow rate of A is 10 mol min^{-1} and inlet concentration is 2 mol dm^{-3} . The rate law is $-r_A = kC_A$, where $k = 0.1 \text{ min}^{-1}$ at 375 K. The volume is 500 dm^3 . The activation energy is 10 kcal/mol. Write a MATLAB program to determine the conversion in the CSTR.

Equation for conversion: $X = \frac{k}{k + \frac{Q}{V}}$ where Q is volumetric flowrate and V is reactor volume.

6. Solve the following set of linear equations using MATLAB

$$2a - b + 5c + d = -3$$

$$3a + 2b + 2c - 6d = -32$$

$$a + 3b + 3c - d = -47$$

$$5a - 2b - 3c + 3d = 49$$

Using a. inverse of coefficient matrix

b. backslash (\)