**McGill University Department of Electrical and Computer Engineering**

**ECSE 443 Introduction to Numerical Methods Winter 2019**

**Assignment #2 Posted: FEB 15 8:00 DUE: Feb 22: 17:00**

Solve all problems. Show all your work, include all source code. All programs should be well documented, and the methods used should be clearly described. Clearly indicate the final answer. Follow instructions in the question. The assignment must be written using a word processor such as Microsoft word. Hand written submissions will not be accepted. For software portions of the project the source code as well as the output of the code will be required as part of the submission. You must include all references and sources that you used. The TA's will be instructed to look for plagiarism or other forms of misconduct and if found, will report the potential misconduct.

**Question 1)** (8 Marks)

For the signal given in the file "***Ass_2_Q1_data***" text file, write a program/MATLAB script that will attempt to find the best fit curve (by having the least square error) using either normal equations or householder QR method. The models you must test are given in the table below

| **Table 1 functions for curve fitting Question 1** |
|---|
| $f1(t) = a_0 + a_1 t + a_2 t^2$ |
| $f2(t) = a_0 t^{a_1}$ |
| $f3(t) = \frac{1}{a_0 t + a_1}$ |

For *each curve* you must find the coefficients that provide the least square error *and* provide the numerical value of the least square error for *each curve*. You must also provide the code as well as document your code with comments and clearly indicate the methods used in the code.

**Question 2) (6 Marks)**

Write a computer program/MATLAB script to apply the bi-section method to obtain the all of the roots of the function: $f(x) = x^3 - 2x^2 + \frac{4}{3}x - \frac{8}{27}$ to the accuracy of $10^{-8}$ (the roots must be accurate to this order). Show your work, documented code and results.

**Question 3) (8 Marks)**

Your design team is tasked with identifying the frequency of oscillation of data from a sensor. The sensor data is given in the file "***Ass_2_Q3_data***". Using the secant method and knowledge of signal, determine the frequency of oscillation of the signal in the data file. Show your work, documented code and results.

**Question 4) (8 Marks)**

The output of a generator, as a function of frequency ($\omega \; which \; is \; in \; units \; of \; kHz$), is given by: $P(\omega) = 100[1 - e^{-0.56\omega}]$. The energy dissipated, (used), by the system as a function of frequency is given by: $E(\omega) = \omega^2 - 5\omega + 30$. Using Newton's method identify the operating frequency where both relationships are satisfied, with an accuracy of $10^{-8}$. Show your work, documented code and results.