CISE 301 – Numerical Methods
Spring 2011 (Term 102)

Project

Question # 1: Analysis of the Problem and Data Set (20 points)

- **a.** Work either individually or in a team of two students to choose one problem among the two problems described at the end of this document.
- **b.** **(5 Points)** Analyze the provided data set, and list the numerical methods (studied in this course) that can be used to find a solution to the chosen problem in question (a).
- **c.** **(5 Points)** Describe how these methods can be used and state what the expected outcome is for each.
- **d.** **(10 Points)** Describe which method is the most appropriate to use and why. It is up to you to select the most appropriate method for solving the problem and computing the values. You need to justify your selection.

Question # 2: Implementation of Selected Method (50 points)

- **a.** **(40 Points)** Develop a program of the selected method for solving the problem chosen in Question#1. Write the program using MATLAB.
- **b.** **(10 Points)** Add comments to explain your program.

Question # 3: Verification of the Results Obtained (30 points)

- **a.** **(5 Points)** Verify the results for simple values.
- **b.** **(5 Points)** Provide the results in a table.
- **c.** **(5 Points)** Plot the results obtained.
- **d.** **(15 Points)** Comment on the obtained results.

To Be Submitted:

- A hard copy of the report with:
    1. Cover page (Name(s), ID(s), Course, Term, Date)
    2. Introduction (Statement of the problem)
    3. Analysis of the Data Set and Problem (Q1)
    4. Pseudo-code of your program (Q2)
    5. The table and plot (Q3)
    6. Conclusion (Your analysis of the obtained results) (Q3)
    7. Appendix (Listing of your program. Add comments to explain them. Write your name and ID at the top of your programs.) (Q2)
- Soft copies of the report and program should be submitted through WebCT.

Bonus: For solving Both problems (30 points)

Problem 1 (EE)

In electronics, we are given an electronic circuit that represents the active 2^{nd} order High pass filter. And, we are able to analyze it through the lab equipments experimentally. We are varying the frequency and applying an input voltage and then observing the output voltage. Since the output is varying when the frequency is varying, the gain is therefore varying and it changes with a known relation that is:

$$T(s) = \frac{a_2 s^2}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2}$$

Where

- s represents the frequency and $T(s)$ represents the gain.
- a_2 *is High Frequency Gain*
- Q is the *Quality factor*
- ω_0 is the -3*dB frequency at which the gain is* $\frac{1}{\sqrt{2}}$ *of maximum gain*

We want to determine these values: ω_0, Q, and a_2, and obtain the transfer function of the high pass filter which allows us to determine the gain at a specific given frequency.

The experimental values of [High Pass Filter] are as follows:

Frequency (Hz)	Input Voltage (Vi)	Output Voltage (Vo)	Gain (Vo/Vi)
10	1.64	0.014	0.009
20	1.96	0.074	0.038
30	1.96	0.150	0.077
40	2.00	0.260	0.130
50	2.04	0.408	0.200
60	2.04	0.592	0.290
70	2.04	0.840	0.412
80	2.04	1.100	0.539
90	2.04	1.400	0.686
100	2.04	1.740	0.853
110	2.04	2.160	1.059
120	2.04	2.560	1.255
130	2.04	2.960	1.451
150	2.04	3.680	1.804
160	2.04	4.00	1.961
170	2.04	4.320	2.118
180	2.04	4.480	2.196

190	2.04	4.640	2.275
200	2.04	4.640	2.275
220	2.04	4.720	2.314
230	2.04	4.800	2.353
240	2.04	4.800	2.353
250	2.04	4.800	2.353
260	2.04	4.720	2.314
270	2.04	4.640	2.275
280	2.04	4.640	2.275
300	2.04	4.640	2.275
330	2.04	4.640	2.275
340	2.04	4.560	2.235
350	2.04	4.480	2.196
370	2.04	4.480	2.196
400	2.04	4.480	2.196
420	2.04	4.400	2.157
430	2.04	4.320	2.118
450	2.04	4.320	2.118
470	2.04	4.320	2.118
500	2.04	4.320	2.118
550	2.04	4.320	2.118
600	2.04	4.320	2.118
650	2.04	4.320	2.118
700	2.04	4.240	2.078
750	2.04	4.160	2.039
800	2.04	4.160	2.039
900	2.08	4.160	2.000
1 k	2.08	4.160	2.000
4 k	2.16	4.160	1.926
5 k	2.16	4.120	1.907
6 k	2.16	4.120	1.907
40 k	2.16	4.120	1.907
50 k	2.16	4.120	1.907
80 k	2.16	4.120	1.907
90 k	2.16	4.080	1.889

Problem 2 (ME)

We are interested in finding a function that will allow us to determine the specific volume at any temperature, based on the data provided in the following table:

Temperature	Saturated vapor (specific Volume)
5	206
10	147.03
15	106.32
20	77.885
25	57.762
30	43.34
35	32.879
40	25.205
45	19.515
50	12.251
55	12.026
60	9.5639
65	7.667
70	6.1935
75	5.0396
80	4.1291
85	3.4053
90	2.8261
95	2.3593
100	1.9808
105	1.672
110	1.4186
115	1.2094
120	1.036
125	0.89133
130	0.77012
135	0.66808
140	0.58179
145	0.5085
150	0.446
155	0.39248
160	0.34648

165	0.3068
170	0.27244
175	0.2426
180	0.21659
185	0.19384
190	0.1739
195	0.15636
200	0.14089