University of Massachusetts Lowell
Electrical and Computer Engineering
25.108 Intro to Engineering II for ECE
Writing Programs and functions in Matlab

Date: _____

Section # _____

Learning Objectives:

By completing this Lab exercise you should be competent in the following learning objectives:

· Getting more experience with Matlab functions

· Using commands: while, if then – elseif to control program structure

· Writing simple programs in Matlab

Instructions:

Part A. Grading Problem, Using Control Structures

In 25108, all the Labs, MPs and exams consist 600 points. The final letter grade is given according to the following table:

E	0-300
D-	300-320
D	320-340
D+	340-360
C-	360-380
C	380-400
C+	400-420
B-	420-450
B	450-480
B+	480-510
A-	510-540
A	540-570
A+	570-600

In this section, the work is divided into 3 parts: a main program “Convert” that allows you to input the points a student earned, a function “Grade” which decides which letter grade the student should get, and another function “plus_minus” which decides whether the student should get + or –.

The outlines of these 3 parts are given below, you should fill in your code to make them run.

Convert.m

```
…
Points = input ( … ); % ask user to input the points a student earned
Finalgrade = Grade(Points); %calls function Grade to decide the letter grade
…
```

Grade.m

```
% Grade function only decides the letter students should get
% It calls plus_minus to decides what goes behind, a “+” or a “-”

Function g = Grade (points)
If points >= 510
g = [‘A’, plus_minus(points, 540, 570)] %Here a concatenation is used
…
```

plus_minus.m

```
% this function returns a “+” or a “-” or nothing.
% this function takes 3 parameters: the points a student got, a low point, a high point.
% when the points is higher than high point, the student gets a “+”
% if the points is lower than low point, he gets a “- ”.

Function pm = plus_minus(points, lpoint, hpoint)
If ….
pm = “-”;
…
```

Example: Steven got 520 points, now we want to know his letter grade. First we run the program “Convert” in Matlab command window. The output is:

```
Convert

Please input the points the student earned: 520

A-
```

_____

What will happen if you input 800 or –20 as the points a student got?

Convert

Please input the points the student earned: 800

_____

How do you solve this problem?

_____

Part B. In this section, you are going to write a function that can adds two polynomials of different degree.

1. Given two polynomials: P = x^3 + 2x^2 +3x +1, Q = x –1.

How to represent them? P = _____, Q = _____.

What will happen if you want to add them up using P+Q?
_____

2. We can not sum two vectors with different dimensions. We have to make their dimensions the same by adding 0's to Q. The function zeros(a,b) can help.

Try commands zeros(2,3) and zeros(1,4).
What's the result of function zeros(a,b)? _____

Now write down a command that change Q's degree to the same as P, without changing Q's value.

Q = _____

3. Refer to notes for the use of function size(p).

Now suppose we have two polynomials R and S, we only know that R has a lower degree than S. By using a combination of commands size and zeros, we can change R's degree to the same as S's.

Vec = (size(R) – size(S)) % get the difference between R and S
% vec(2) will be the difference.

R = [zeros(_____), S] % concatenate zeros and S

4. Write a function adding two polynomials of different degrees and give out the sum as result.

For example, your function should behave as follows:

Add(P,Q)

ans =
[1,2,4,0]

Hint: your function should be able to sum up any two given polynomials, so you may first decide which polynomial has a higher degree. Use the results of step2 and step3.

Part C. Chebyshev polynomials.

Chebyshev polynomials are defined as follows:
$T_0(x) = 1;$
$T_1(x) = x;$
$T_n(x) = 2xT_{n-1}(x) - T_{n-2}(x)$

Write a function "Cheby(n)" that returns the Chebyshev polynomial for a given n in MATLAB vector polynomial format..

For example, your function will do the following:

Cheby(2)
ans=
[2, 0, -1] for T2 = $2x^2 - 1$

The structure of the function is given below, you should fill in necessary code to make it run.

Function c = Cheby(n)

c0 = [1];
c1 = [1,0]; % initialization for Cheby(0) and Cheby(1)
i = 1; % initialization for loop control variable used in while loop

if n = 0
_____;
elseif n = 1

```
_____;
else
ci2 = c0; % ci2 always represents Cheby(i-2)
ci1 = c1 % now i = 1, ci1 always represents Cheby(i-1)

% in the following loop, the program always computes Cheby(i)
% as i increases, all the Chebyshev polynomials Cheby(2), Cheby(3)…are calculated
% when i hits n, Cheby(n) is calculated.

while i < n
        i = i + 1;
        ci = _____; % now i increases, we calculate
        the
        % new cheby(i) accordingly.
        % Hint: ci = 2x ci1 - ci2
        % you should utilize the "add" function implemented in Part B
        % and to multiply c(i-1) with 2x, command conv should be used.
        ci2 = ci1;
        ci1 = ci;

end
```

Use the command "roots" to find all the roots of Cheby(5) and Cheby(10).

Hand in you code for each of the 3 parts to your TA. This lab counts for 3 Grading Units