EE351M Digital Signal Processing
Dept. of Electrical and Computer Engineering
The University of Texas at Austin
Homework #1

Date assigned: January 19, 2005
Date due: January 24, 2005, beginning of class

Reading: Introduction
Discrete-Time Signal Processing, Chapter 1

Problem 1.1: Complex Numbers

Simplify the following complex-valued expressions:

a) \(3e^{j\pi/3} + 4e^{-j\pi/6}\)
b) \((\sqrt{3} - j3)^{10}\)
c) \((\sqrt{3} - j3)^{-1}\)
d) \((\sqrt{3} - j3)^{1/3}\)
e) \(\Re\left(j e^{j\pi/3}\right)\)

Please give the answer in both Cartesian \((x + jy)\) and polar \(re^{j\theta}\) forms.

Problem 1.2: Euler’s Formula

Remember that Euler’s famous formula for the complex exponential is

\[ e^{j\theta} = \cos \theta + j \sin \theta \]

Use the following series expansions to show Euler’s formula

\[ e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots \]
\[ \cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \cdots \]
\[ \sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \cdots \]

Problem 1.3: Introduction to MATLAB

MATLAB is a powerful technical-computing language especially for digital signal processing problems. It is available on the ECE LRC machines. In UNIX you can start it by typing `matlab` on the command prompt. MATLAB has extensive internal help and demo functionality that can be accessed by typing help and demo within MATLAB respectively. The tutorial at http://www.utexas.edu/cc/math/tutorials/matlab.html might be useful in getting familiar to MATLAB.
Create the following MATLAB script (also called an m-file) in MATLAB’s own editor or you favorite text editor, name it myfirst.m. Run the script in MATLAB by typing myfirst.

```matlab
clear all
close all

t = -1:0.01:1;
fo = 2;
x = 10 * real( exp( j * (2 * pi * fo * t + pi/4)));

plot(t,x)
grid on
title('yourname''s sinusoid plot')
xlabel('time (s)')
ylabel('amplitude')
```

a) Print the resulting plot and turn it in with your assignment.

b) What value do you see the graph has at time = 0? You can check the value in MATLAB by typing `x(1)` in the MATLAB prompt. Derive that value from the equation of `x` given in MATLAB code.

c) Change `fo` to be equal to 4 in code. Run the script again. Describe the difference between the first and second plots. Print the second plot and turn in with your assignment.