ECE 2610 Lab Worksheet:
MATLAB Intro & Complex Arithmetic

1/24/2011

MATLAB as a Complex Number Calculator

- Functions used: `real()`, `imag()`, `abs()`, `angle()`
- Compare the three angle producing functions: `angle()`, `atan2()`, and `atan()`

Practice Problems (very similar to Set #1)

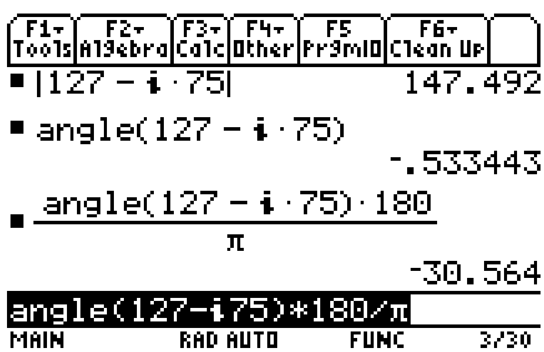
For each of the problem below work out the answer using both MATLAB and your calculator

1. Write $127 - j75$ in polar form; find the angle in both radians and degrees.

```
>> z = 127 - j*75;
>> abs(z)
      ans =  147.4924
>> angle(z)
      ans =   -0.5334   % In radians
>> angle(z)*180/pi
      ans =  -30.5640   % In degrees
```

Hand/Calculator workspace:

From TI89
using the numerical
evaluate mode
(green diamond
button, them press
enter)



- Since this number lies in quadrant IV, we are OK using the atan( ) to find the angle
- Watch out if in quadrant II or III
- Best to plot the complex number as a vector

2. Write $z = 22\angle{-110°}$ in rectangular form.

>> z = 22*exp(-j*110*pi/180)

z = -7.5244 -20.6732i

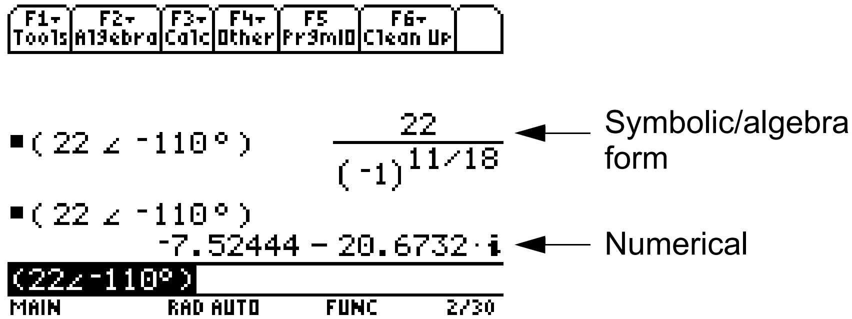
>> real(z)

ans = -7.5244

>> imag(z)

ans = -20.6732

Hand/Calculator workspace:



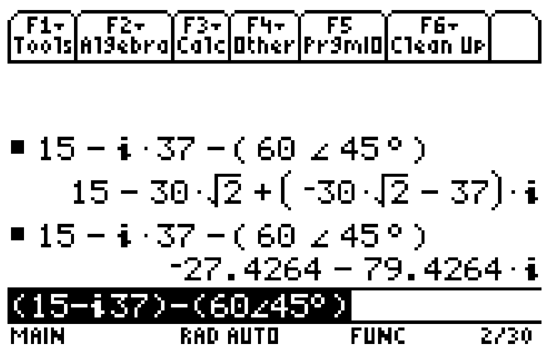
3. Evaluate $z = (15 - j37) - 60\angle 45°$ to a rectangular form solution.

MATLAB Steps:

```
>> (15 - j*37) - 60*exp(j*45*pi/180)

ans =  -2.7426e+01 - 7.9426e+01i
```

Hand/Calculator workspace:



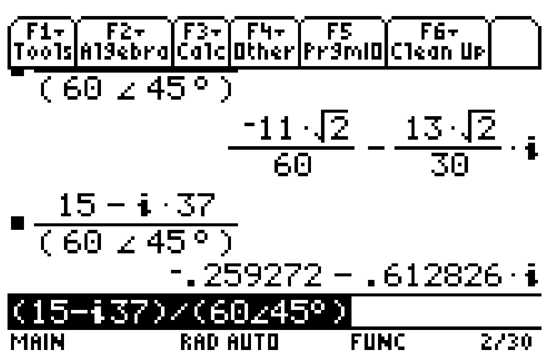
4. Evaluate $z = (15 - j37)/60\angle 45°$ to a rectangular form solution.

MATLAB Steps:

```
>> (15 - j*37)/(60*exp(j*45*pi/180))

ans =  -2.5927e-01 - 6.1283e-01i
```

Hand/Calculator workspace:

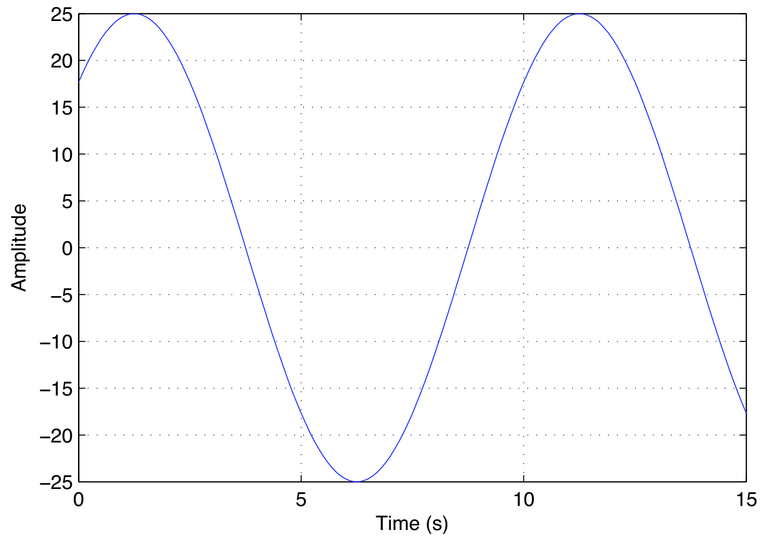


MATLAB for Plotting Data and Functions

- Functions used: `plot()`, `xlabel()`, `ylabel()`, `title()`, `grid`, and `axis`

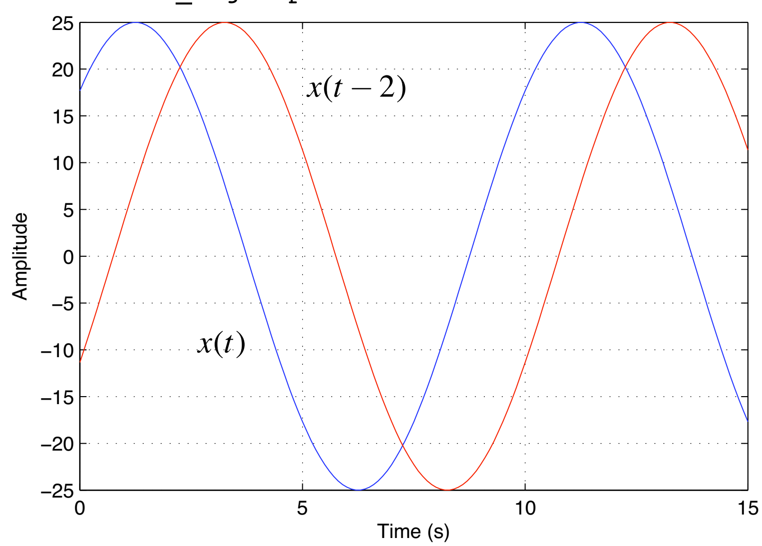
1. Plot $x(t) = 25\sin(\pi t/5 + \pi/4)$ for $0 \le t \le 15$ s. Include a grid and axis labels.

```
>> t = 0:.1:15; % create a time axis vector with sample spacing 0.1s
>> plot(t,25*sin(pi*t/5+pi/4))
>> grid
>> xlabel('Time (s)')
>> ylabel('Amplitude')
>> print -depsc -tiff wks_fig1.eps
```



For the $x(t)$ above, plot $x(t-2)$ for $0 \le t \le 15$ s, overlaid on the plot of $x(t)$ of part (1).

```
>> hold on % will hold the previous plot so you can overlay a new plot
>> hold
Current plot held
>> plot(t,25*sin(pi*(t-2)/5+pi/4),'r')
>> print -depsc -tiff wks_fig2.eps
```



User Defined Functions in MATLAB

One of the most power capabilities of Matlab is being able write your own user defined functions. Consider a custom trig function of the form

$$y(t) = 3\cos(t) + 4\sin(3t) \tag{1}$$

The input to this function is time, t, and the output is y. The function *prototype* we require is of the form:

```
function y = my_trig(t)
% y = my_trig(t) is a function that evaluates the simple trig
% based function y = 3*cos(t) + 4*sin(3*t).
%
% Author: My Name
% Date: January 2011
%
…
function body
…
make sure that you return output to variable y
```

Write the Function

```
function y = my_trig(t)
% y = my_trig(t)
% Mark Wickert, January 2011

y = 3*cos(t) + 4*sin(3*t);
```

Test the Function

To test the function input a time vector that runs from -2s to 10s using a time step of 0.05s. Output the results in a plot using `plot(t,y)`.

```
>> t = -2:.05:10;
>> y = my_trig(t);
>> plot(t,y)
>> grid
>> xlabel('Time (s)')
>> ylabel('Amplitude')
>> print -tiff -depsc
fig1.eps
```