Al-Mustaqbal University / College of Engineering & Technology
Department (Chemical and Petrochemical engineering)
Class (second stage)
Subject (Computer Programming**)**
Lecturer (Abrar Falah Naji)
2nd term – Lecture No. & Lecture Name (2D Graphics)

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2D Graphics

One of Matlaba most powerful features is the ability to create graphic plots. There are so many methods of generating graphics in Matlab.

1. X-Y Plots

A Cartesian or x,y plot is based on plotting the x,y data pairs from the specified vectors. Clearly, the vectors x and y must have the same number of elements. Given a vector x of *x*-coordinates x_1 through x_n and a vector y of *y*-coordinates y_1 through y_n, plot(x,y) graphs the points (x_1,y_1) through (x_n,y_n).

For example, to plot the two dimensions corresponding to (0,0), (1,1), (4,2) , (5,-1) and (0,0) points .

x=[0 1 4 5 0]; y=[0 1 2 -1 0];

plot(x,y)

The command plot(x,y) opens a graphics window and draws an *x-y* plot of the elements of *x* versus the elements of *y*.

To plot the graph of $y=x^3$ on the interval [2,2], first define a row vector whose components range from -2 to 2 in increments of .05. Then define a vector y; of the same size as x whose components are the cubes of the components of x. Finally use the plot function to display the graph.

x=-2:.05:2; y=x.^3;

plot(x,y)

You can, also for example, draw the graph of the sine function over the interval -4 to 4 with the following commands:

x = -4:.01:4;
y = sin(x); plot(x,y)

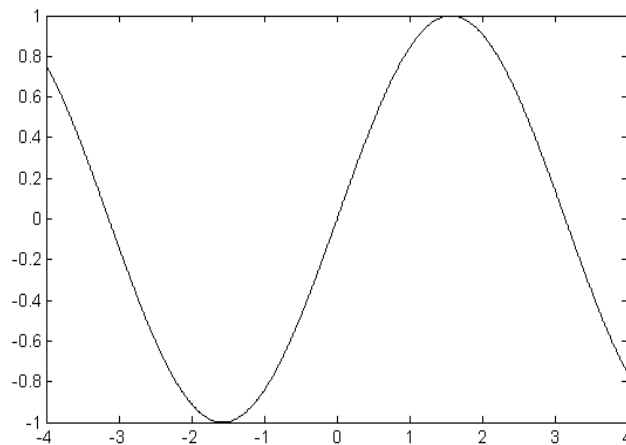The resulting plot is shown in figure 1

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Figure 1. Plotting sine over the interval -4 to 4

Plots of parametrically defined curves can also be made. Try, for example,

t=0:.001:2*pi;

x=cos(3*t); y=sin(2*t); plot(x,y)
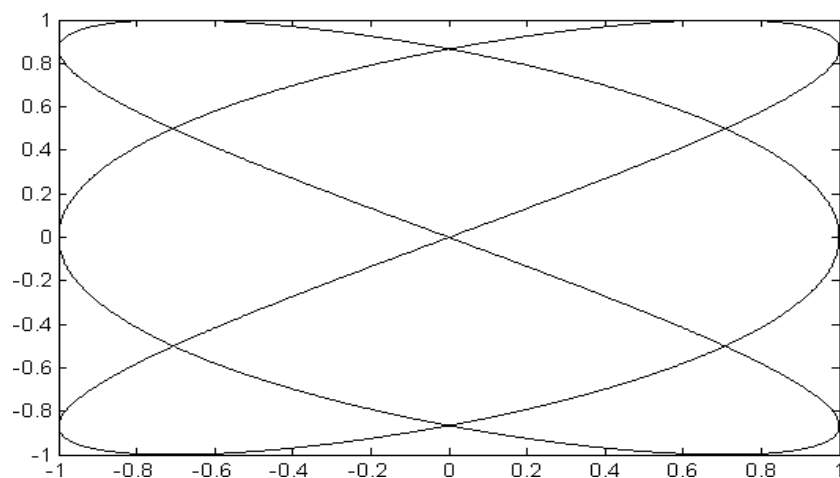
The resulting plot is shown in figure 2.

Figure 2. Plotting parametrically curves

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2. Grid

A dotted grid may be added to the plot by:

grid on

This grid can be removed using grid off.

grid off

3. Controlling Axes

Once a plot has been created in the graphics window you may wish to change the range of *x* and *y* values, this can be done by using the command "axis" as follows:

x =0:.01:1;

**y
=sin(3*pi*x
); plot(x,y)**

axis([-0.5 1.5 -1.2 1.2])

The axis command has four parameters, the first two are the minimum and maximum values of *x* to use on the axis and the last two are the minimum and maximum values of *y*.

4. Plotting Line Style

Matlab connects a line between the data pairs described by the vectors. You may wish to present data points and different type of connecting lines between these points. Data points can be described by a variety of characters such as (. , + , * , o and x .).

Various line types, plot symbols and colors may be obtained with plot(x,y,S) where S is a character string made from one element from any or all the following 3 columns:

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Character color	Character symbol	character line style
b blue	. point	- solid
g green	o circle	: dotted
r red	x x-mark	-. dashdot
c cyan	+ plus	-- dashed
m magenta	* star	
y yellow	s square	
k black	d diamond	
	v triangle (down)	
	^ triangle (up)	
	< triangle (left)	
	> triangle (right)	
	p pentagram	
	h hexagram	

For example,
plot(x,y,'k+:') plots a black dotted line with a plus at each data point.
plot(x,y,'bd') plots blue diamond at each data point but does not draw any line.
plot(x,y,'y-',x,y,'go') plots the data twice, with a solid yellow line interpolating green circles at the data points.
5.   Annotation
The last step before printing or saving a plot is usually to put a title and label the axes. You can put labels, titles, and text on a plot by using the commands:
xlabel('text')
ylabel('text') zlabel('text') title('text')
text(x,y,'text') places text at position x,y
gtext('text') use mouse to place text
For example the graphs can be given titles, axes labeled, and text placed within the graph with the following commands;

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t = 0:0.02*pi:2*pi;

plot(t,sin(t))

xlabel('time');ylabel('amplitude');title('Simple Harmonic Oscillator')
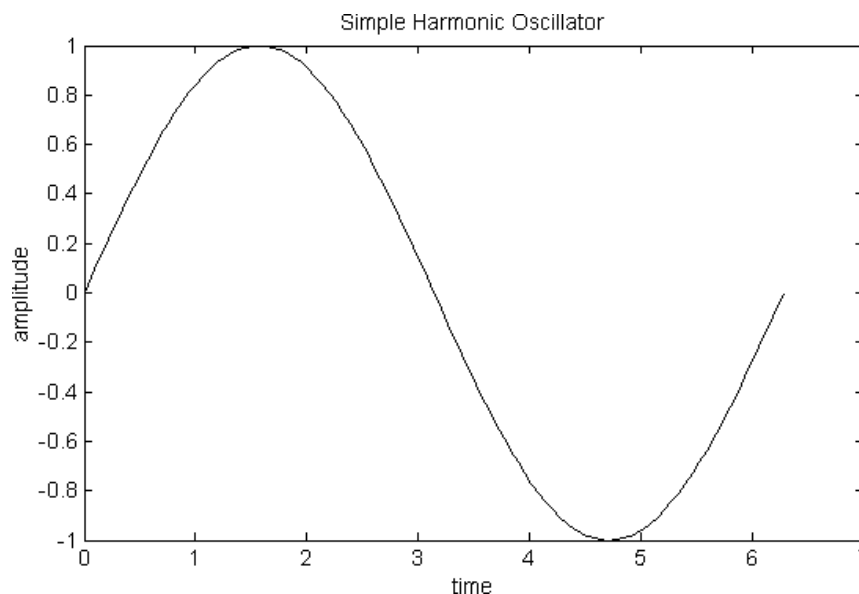
The resulting plot is shown in figure 3.

Figure 3. Using annotation in plot

6.Multi–plots

There are two ways to make multiple plots on a single graph are illustrated by.

6.1Multiple Data Vectors Plots

You can create multiple graphs by using multiple data vectors, for example:

x=0:.01:2*pi;

y1=sin(x);y2=sin(2*x);y3=si
n(4*x); plot(x,y1,x,y2,x,y3)

The re resulting plot is shown in figure 4.

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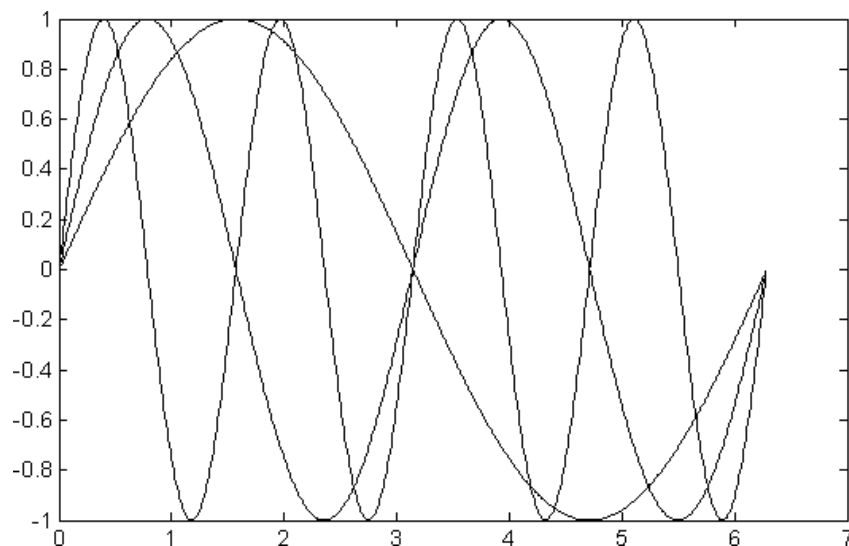**2nd term – Lecture No. & Lecture Name (2D Graphics)**

Figure 4. Multiple plots of sine vectors

3.1 Multiple Plots with Hold

Another way is with hold on. The command "hold on" holds the old graph when the new one is plotted. The axes may, however, become rescaled. "hold on" holds the current picture; "hold off" releases it (but does not clear the window).

Here is an example. Suppose we want to compare the log function with the square root function graphically. We can put them on the same plot. By default, both plots will appear in blue, so we will not know which log. We could make them different colors using options. Here is the final answer,

x=1:100;

y=log(
x);
z=sqrt
(x);

plot(x,y,'r'); % plot log in
red hold on;

plot(x,z,'b'); % plot sqrt in
blue hold off;

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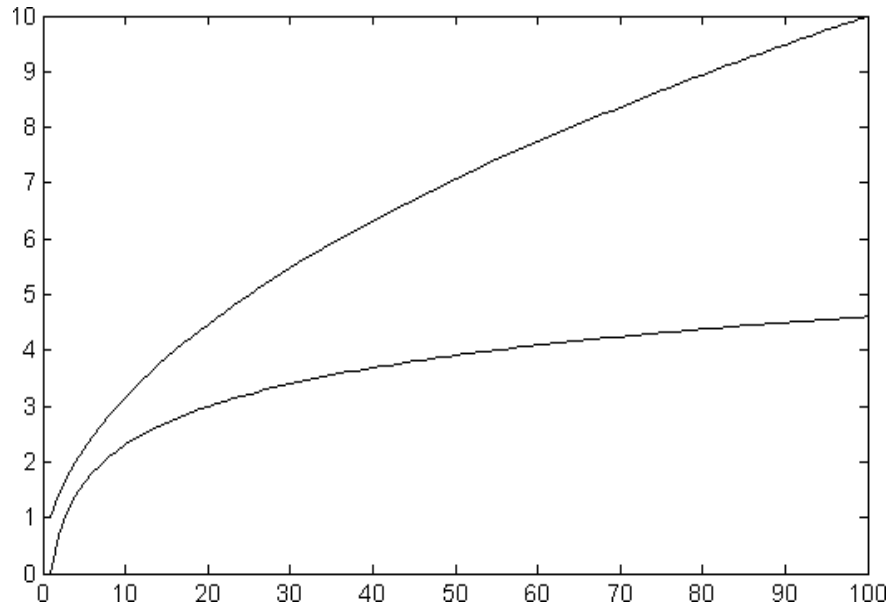
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The resulting plot is shown in figure 5.

Figure 5. Multiple plots with hold

7.Subplot

The graphics window may be split into an *m by n* array of smaller windows into which we may plot one or more graphs. The windows are numbered 1 to *m by n* row–wise, starting from the top left. All of plot properties such as hold and grid work on the current subplot individually.

x=0:.01:1;

subplot(221), plot(x,sin(3*pi*x))
xlabel('x'),ylabel('sin (3pix)')
subplot(222), plot(x,cos(3*pi*x))
xlabel('x'),ylabel('cos (3pix)')
subplot(223), plot(x,sin(6*pi*x))
xlabel('x'),ylabel('sin (6pix)')
subplot(224), plot(x,cos(6*pi*x))
xlabel('x'),ylabel('cos (6pix)')

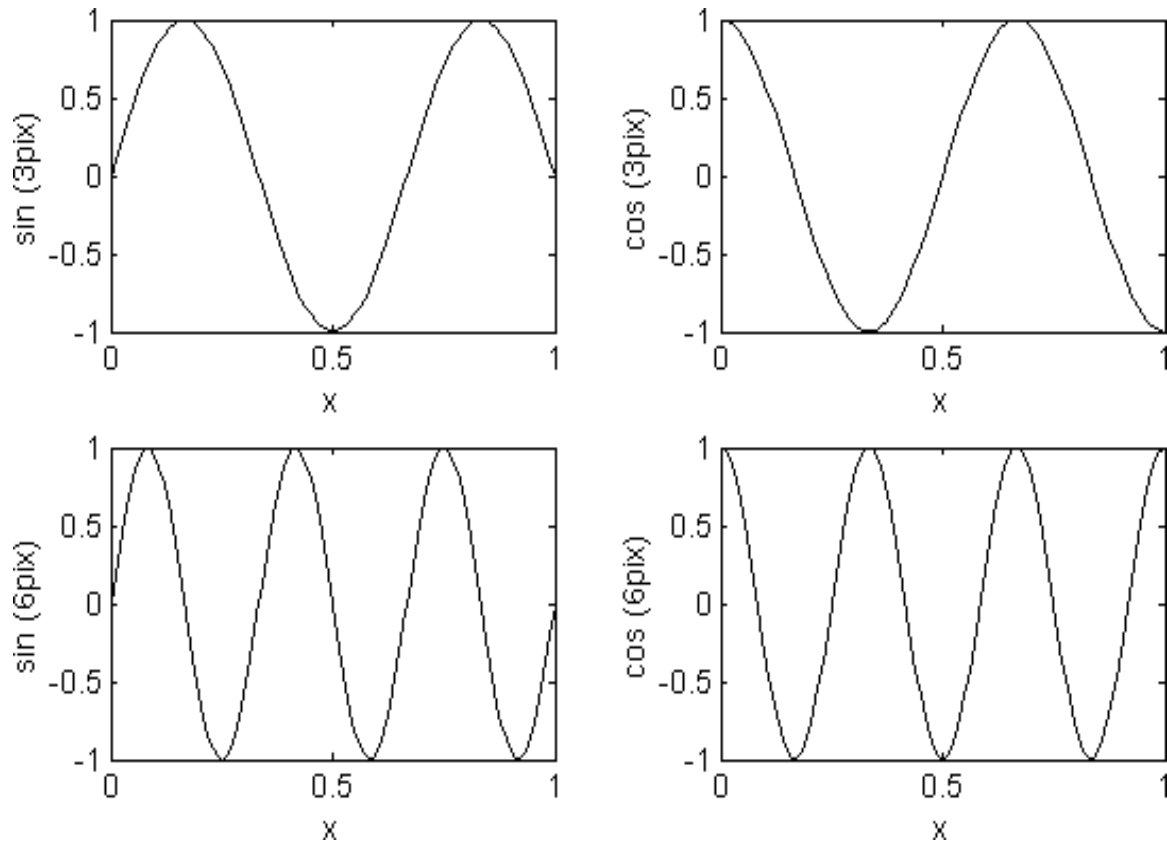The resulting plot is shown in figure 6.

Figure 7. Using subplot

Subplot(221) (or subplot(2,2,1)) specifies that the window should be split into a 2 by 2 array and we select the first sub-window.

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Exercise 1:

The laminar velocity profile in a pipe, can be given in equation $V_x = V_{max}(1 - (2*r/di)^2)$

Plot the velocity profile in a pipe? If you know

that:s r= distance from pipe center

di: Inner diameter of pipe (di=0.2 m)

V_{max}: maximum velocity in pipe (V_{max}=2 m)

Solution

Write the following code
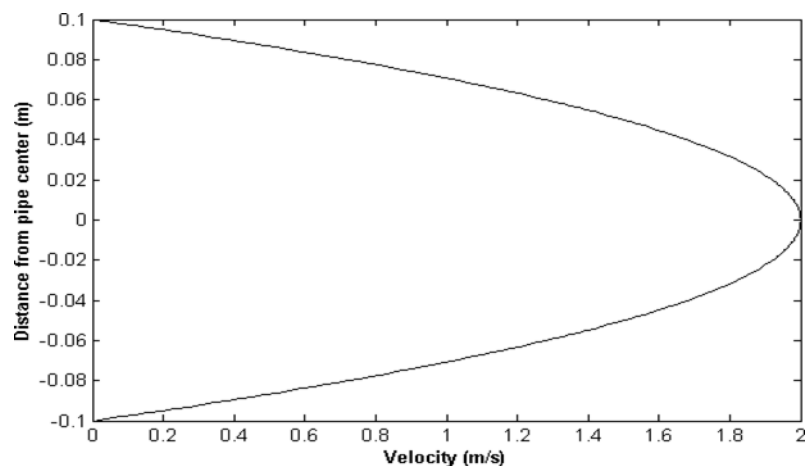
di=.2;

Vmax=2

r=-

.1:.001:.1

Vx=Vmax*(1-

((2*r)/di).^2) plot(Vx,r)

xlabel('Velocity(m/s)'

ylabel('Distance from pipe center (m)')

The result will be the figure.

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Exercise 2:

Plot k as a function of temperature from 373 to 600 k (use 50 point of Temperature). If you know:

K=A exp(B-(C/T)-ln(D*T)-E*T+F*T^2)

Where

A=3.33 , B=13.148 , C=5639.5 , D=1.077 , E=5.44*10^{-4} , F=1.125*10^{-7}
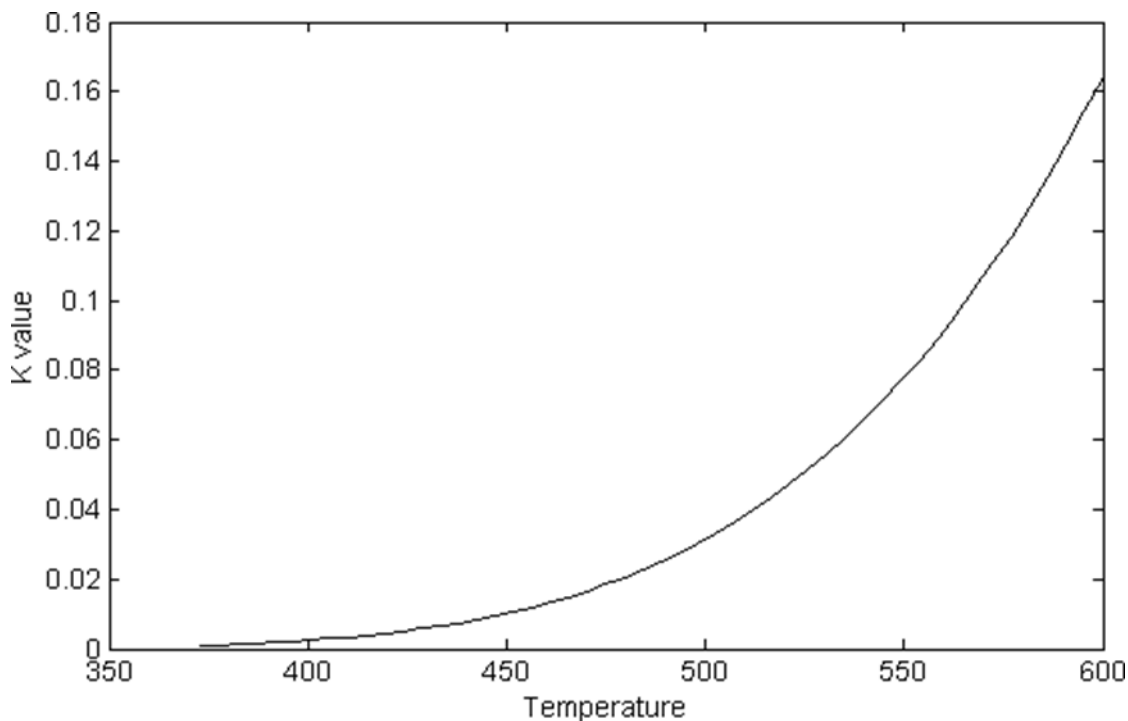
Solution:

Write the following code

A=3.33; B=13.148; C=5639.5; D=1.077; E=5.44e-4; F=1.125e-7;

Ts=(600-373)/49;%Ts means temperature increment T=373:Ts:600

K=A*exp(B-(C./T)-log(D*T)-E*T+F*T.^2) plot(T,K)

xlabel('Temperature') ylabel('K value')

The result will be the figure.

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Exercise 3:

Plot Txy diagram for ethanol/water system. Knowing that the vapor pressures for three components are calculated by:

Ethanol   Poe=exp(18.5242-3578.91/(T-50.5))

Water   Pow=exp(18.3036-3816.44/(T-46.13))

Where Ki= P oi /Pt Pt=760

yi =Ki×xi

At Bubble point ∑yi=∑Ki×xi =1

Solution:

Xe=0:.1:1; Xw=1-Xe;

for m=1:11

for T=273.15:.01:450;

Pe=exp(18.5242-3578.91/(T-50.5)); % Vapor pressure of Ethanol
Pw=exp(18.3036-3816.44/(T-46.13)); % Vapor pressure of Water Ke=Pe/760; % Ethanol

Kw=Pw/760; % Water sum=Ke*Xe(m)+Kw*Xw(m); if sum>1

break

end

 end

Temp(m)=T; ye(m)=Ke*Xe(m); end

plot(Xe,Temp,'k-+',ye,Temp,'k-*') axis ([0 1 340 380])

xlabel('x,y for ethanol') ylabel('Temperatre K')

title('Txy diagram of ethanol/ water system')

Txy diagram of ethanol/ water system