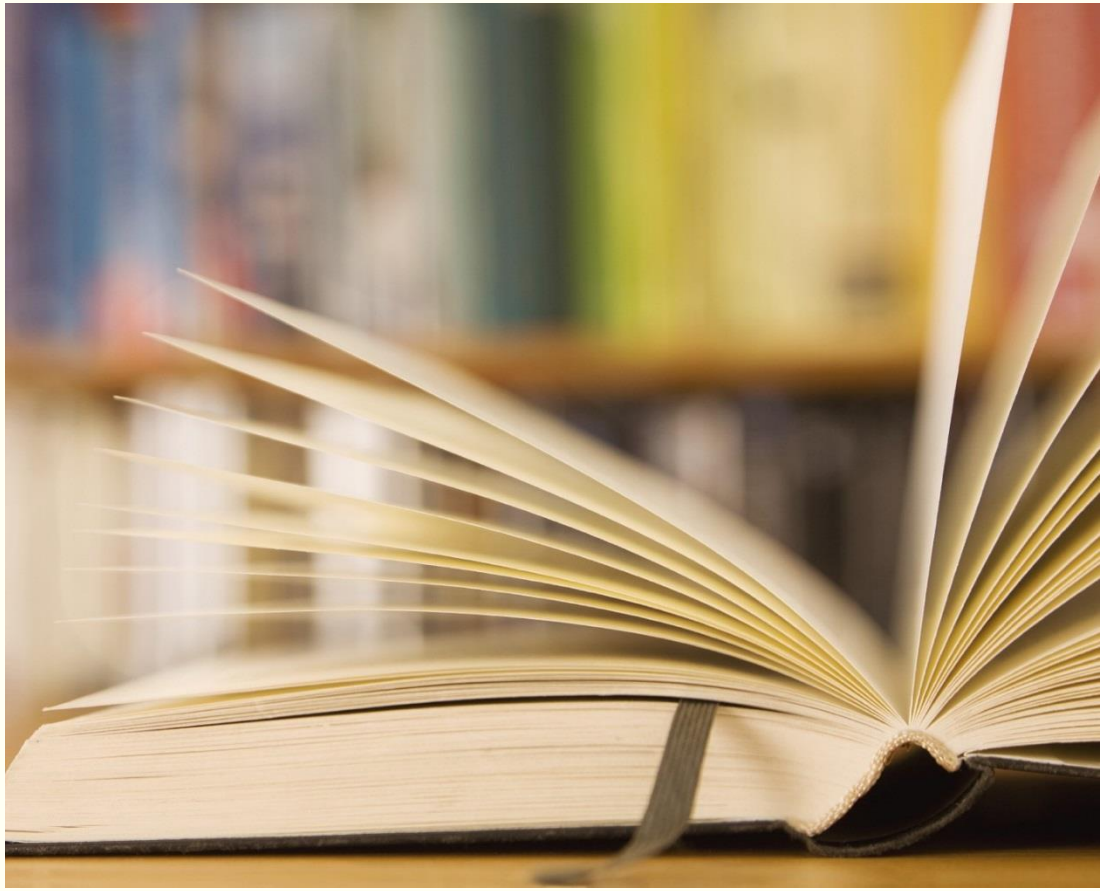
MATLAB SESSION

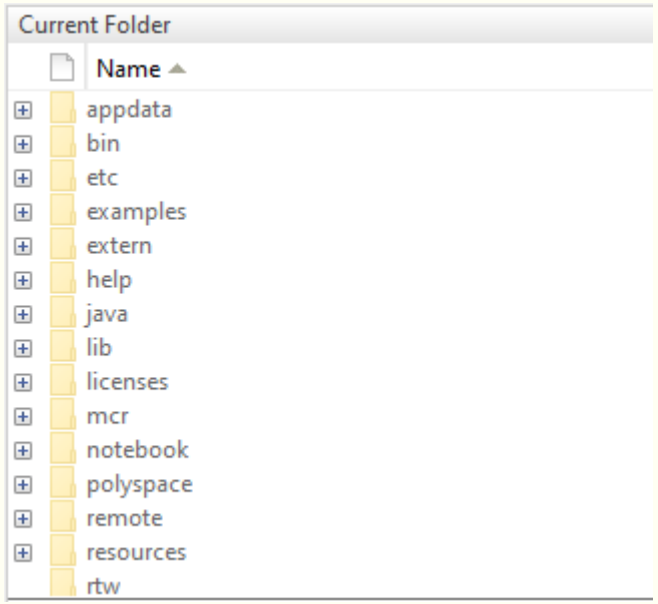


Eng. Rafah Rahhal

Outline

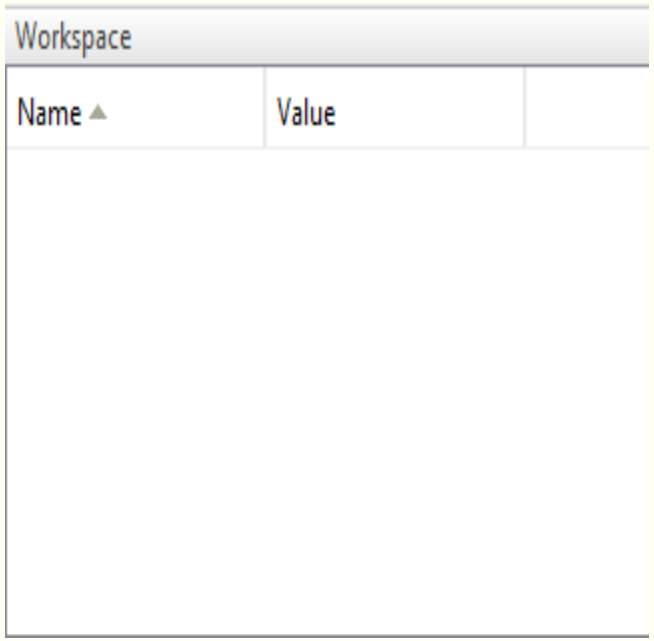
- MATLAB environment.
- Signals plotting.
- Functions types in MATLAB.
- Plotting functions in MATLAB.
- Solving differential equations.
- Convolution of signals.
- System modeling and simulation.
- Step response & semi log scale functions.
- Spectrum Plotting.
- Laplace and Inverse Laplace.

MATLAB Environment



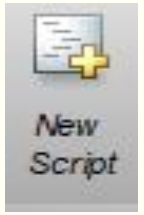
Current folder: To access the project folders and files.

Command Window: The main area where commands entered, it indicated by the command prompt >>.



Workspace: Shows all the variables created and/or imported from files.

MATLAB Environment



Scripts: script files are program files with .m extension. In these files, you write
series of commands, which you want to execute together. Scripts do not accept
inputs and do not return any outputs. They operate on data in the workspace.

RUN: After creating and saving the file, you can run it in two ways:
Clicking the Run button on the editor window or
Just typing the filename (without extension) in the command prompt: >> prog1

Signals plotting

- Example(1):

If we have signal x(t)= sin(t)/2, plot x(t) at t=[0 10], and label axises.

الخطوات:

١- تعريف الفترة الزمنية المراد الرسم فيها.

٢-تعريف ال signalالمراد رسمها.

٣- رسم x بالنسبة للفترة الزمنية t مع مراعاة الترتيب عند الرسم باستخدام function plot.

Plot(t,x) ال x-axis هو t، ال y-axis هو x.

Plot(t,x,'r') يعني رسم x باللون الأحمر.

Plot(t,x,'r','- -') يعني رسم x باللون الأحمر ب خط متقطع.

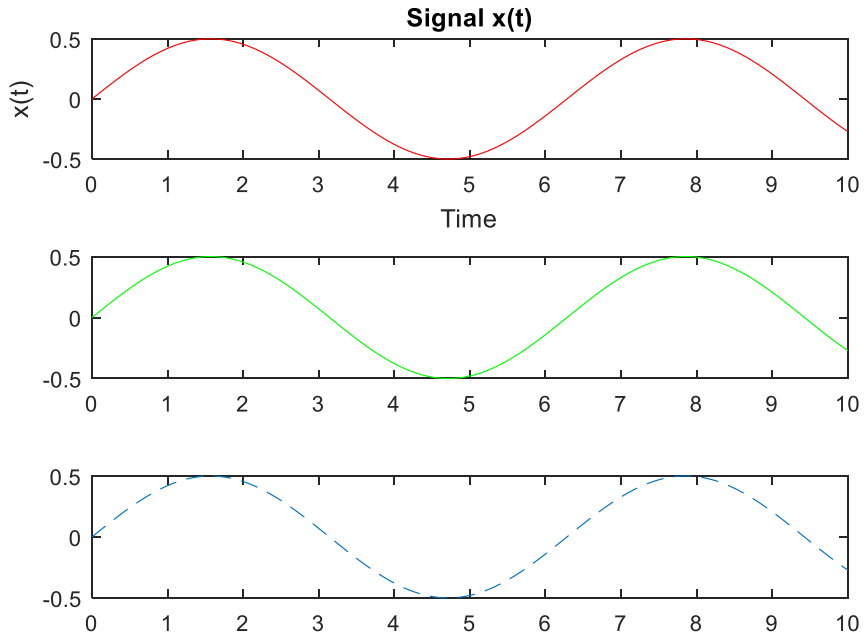
٣- وضع عنوان للرسم، بالإضافة الى تسمية المحاور.

Titleتستخدم لوضع عنوان للرسمة، xlabel تستخدم لتسمية المحور x، ylabel تستخدم لتسمية المحور y.

Signals plotting Command Window

- Example(1):

If we have signal x(t)= sin(t)/2, plot x(t) at t=[0 10], and label axises.




```
>> t=0:0.01:10;
>> x=sin(t)/2;
>> subplot(3,1,1)
>> plot(t,x,'r')
>> title('Signal x(t)');
>> xlabel('Time');
>> ylabel('x(t)');
>> subplot(3,1,2)
>> plot(t,x,'g')
>> subplot(3,1,3)
>> plot(t,x,'*')
```

Signals plotting Using script

- Example(1):

If we have signal x(t)= sin(t)/2, plot x(t) at t=[0 10], and label axises.

Editor - C:\Users\SAQERpc\Documents\MATLAB\Signal_plotting.m

Signal_plotting.m

```
1 -  t=0:0.01:10;
2 -  x=sin(t)/2;
3 -  plot(t,x,'r')
4 -  title('X=sin(t)/2');
5 -  xlabel('Time');
6 -  ylabel('x(t)');
7
8
```

Script

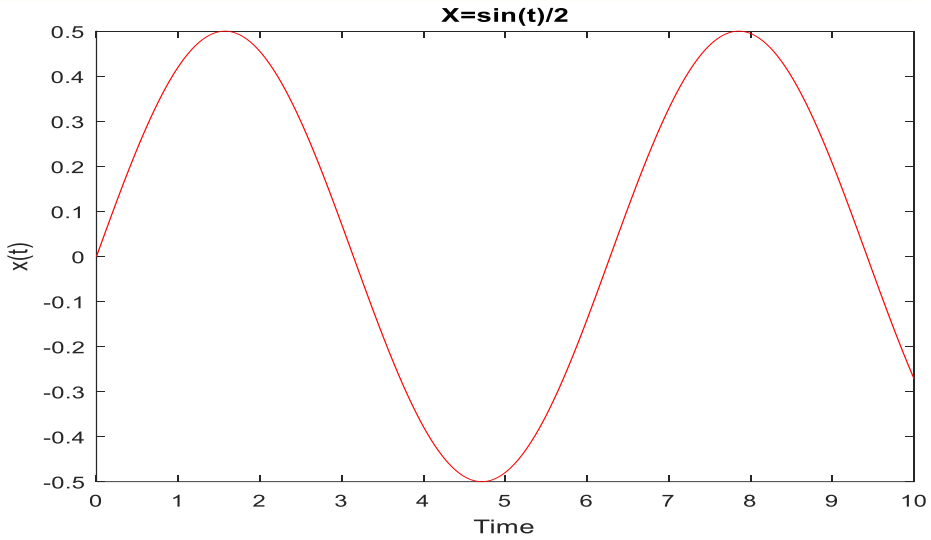
Command Window

New to MATLAB? See resources for Getting Started.

```
>> Signal_plotting
fx >>
```

Command window

To call the script code.



Result

Functions types in MATLAB

- ***Unit step function u(t) :*** the value of which is zero for negative arguments and one for positive arguments, it is also called " Heaviside function" .

In MATLAB we use Heaviside for the unit step function.

- ***Ramp step function r(t):***

In MATLAB we use Heaviside for the ramp step function, eg. Heaviside(t)*(t).

- ***Rectangular function pi(t):*** is called rectangular function or pi function.

In MATLAB we use rectangularPulse.

Plotting Functions Types In MATLAB

- ***plot:***

plot(X,Y) creates a 2-D line plot of the data in Y versus the corresponding values in X.

- ***ezplot:***

ezplot(f) plots the curve defined by the function y = f(x) over the default interval [a b] for x.

ezplot automatically adds a title and axis labels to the plot.

Example:

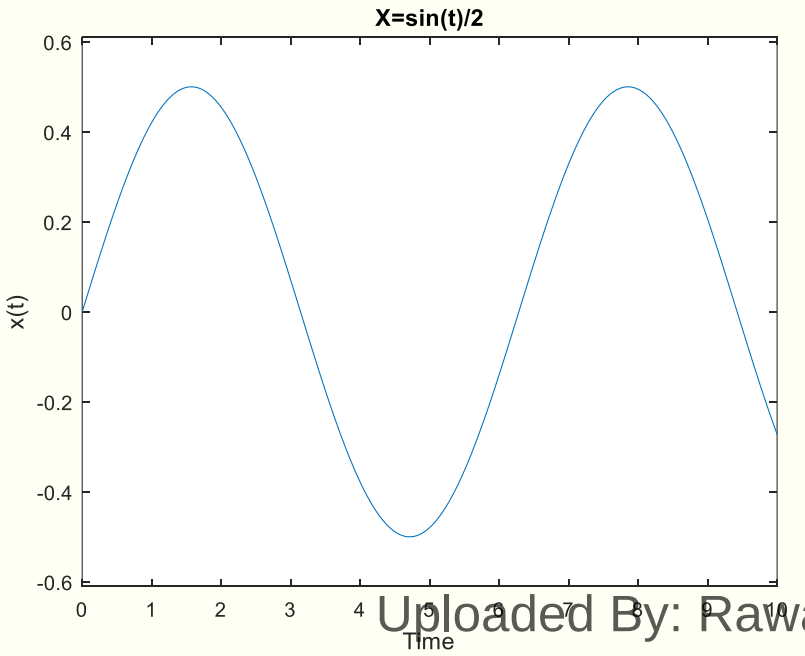
Signal_plotting.m

```
1 -    syms t
2 -    x=sin(t)/2;
3 -    ezplot(x,[0 10])
4 -    title('X=sin(t)/2');
5 -    xlabel('Time');
6 -    ylabel('x(t)');
7
```

Command Window

New to MATLAB? See resources for Getting Started.

```
>> Signal_plotting
>>
```



Creating signals in MATLAB

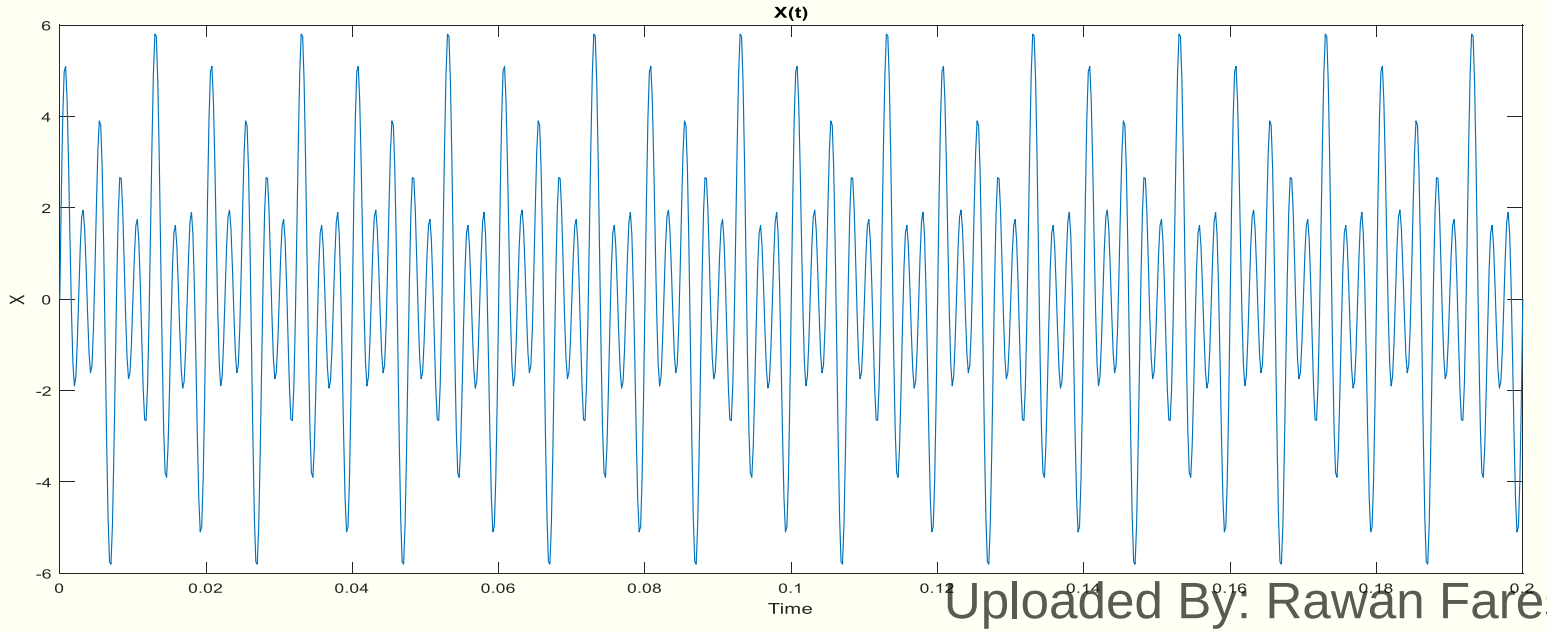
- According to determine a number of samples per second (fs) and number of samples(n).

Example:

Create signal(x) which is the sum of three sine signals of requencies 100, 250 and 400 Hz, with amplitudes of 1,2 and 3 respectively.

The samples per second is 5000 and the number of samples is 1000.

```
>> fs=5000;
>> n=1000;
>> t=0:1/fs:n/fs;
>> x1=1*sin(2*pi*100*t);
>> x2=2*sin(2*pi*250*t);
>> x3=3*sin(2*pi*400*t);
>> x=x1+x2+x3;
>> plot(t,x)
>> title('X(t)');
>> xlabel('Time');
>> ylabel('X');
>> plot(t,x)
>> title('X(t)');
xlabel('Time');
ylabel('X');
```



Solving Differential Equations

- يكون الحل بطريقتين:
- **الطريقة الأولى:**

- ❑ Create the symbolic function y(t) by using “syms”.
- ❑Define the equation using” ==“, and define the differential using “diff”.
- ❑Define the initial condition such as “ condition=y(0)==3”
- ❑Solve the equation using“dsolve”.

Solving Differential Equations

- **الطريقة الأولى:**

Example:

- $10dy(t)/dt + 20y(t) = 10$

Editor - C:\Users\SAQERpc\Documents\MATLAB\Diff_sol1.m

Signal_plotting.m | Diff_sol1.m

```
1 -    syms y(t)
2 -    D2=diff(y)
3 -    D3=y(0)==0;
4 -    x=(10*D2)+(20*y)==10;
5 -    dsolve(x,D3)
6
```

Command Window

New to MATLAB? See resources for Getting Started.

```
>> Diff_sol1

D2(t) =

diff(y(t), t)


ans =

1/2 - exp(-2*t)/2
```

Solving Differential Equations

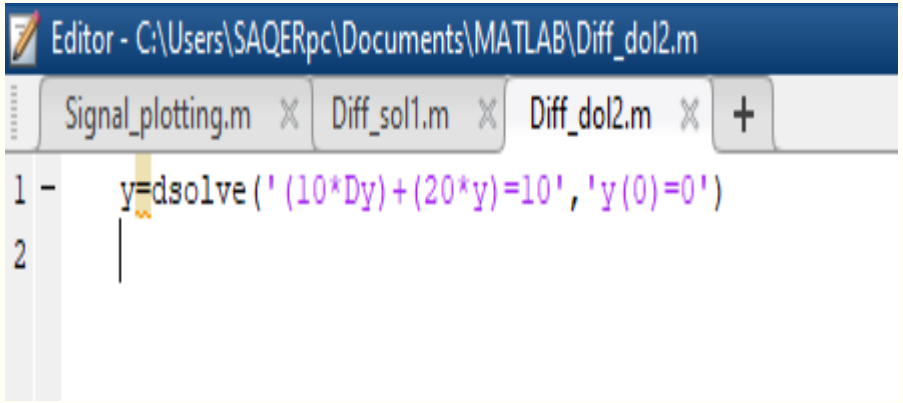
- يكون الحل بطريقتين:
- **الطريقة الثانية:**

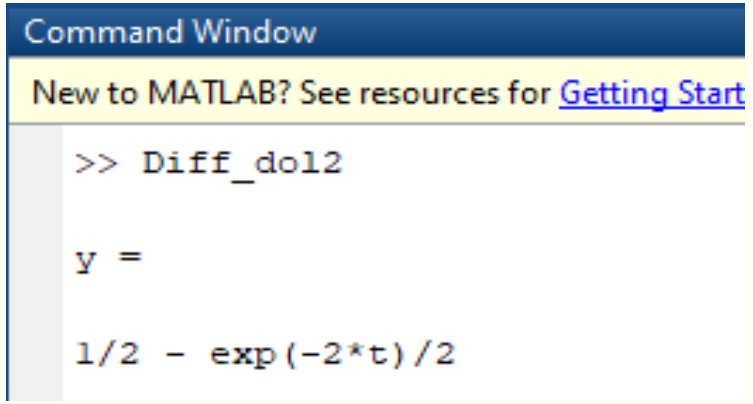
- ❑ Give your function a name.
- ❑Use “dsolve(‘ your equation’, ‘initial conditions’)
- ❑Example:

Y=dsolve(‘3Dy+2y=5’, ‘y(0)=0’)

Solving Differential Equations

- **الطريقة الثانية:**



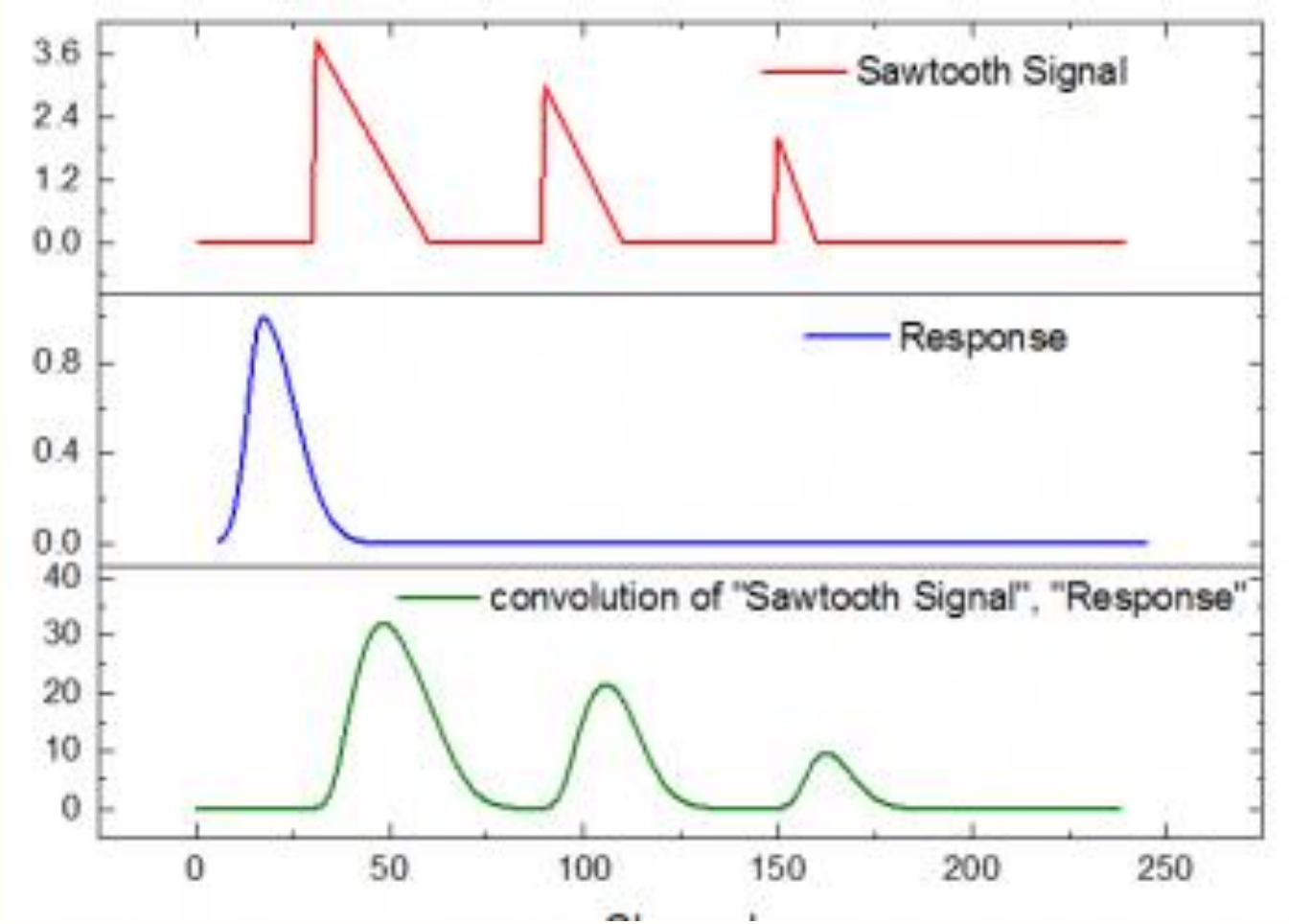


Convolution of signals

Combining two signals form a third signal.

It done by:

- Define the first signal.
- Define the second signal.
- Use “conv” to convolute first and second signals**.**

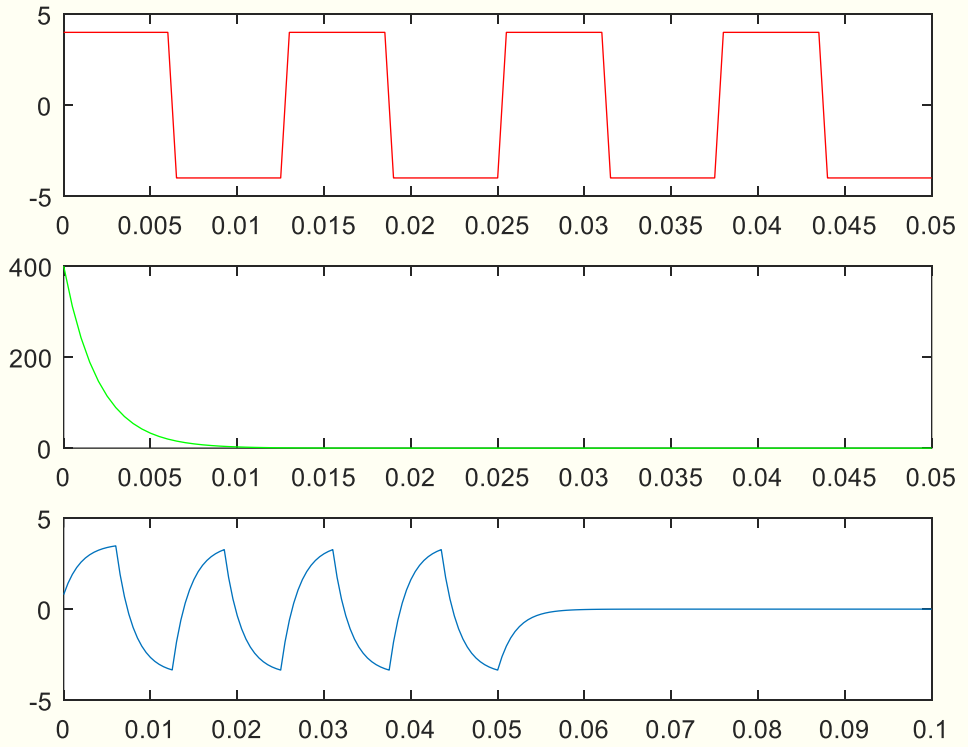


Convolution of signals

Editor - C:\Users\SAQERpc\Documents\MATLAB\Conv.m

Conv.m | Diff_dol2.m

```
1 -  t=0:0.0005:0.05;
2 -  x=4*square(500*t,50);
3 -  subplot(3,1,1)
4 -  plot(t,x,'r')
5 -  x1=400*exp(-500*t);
6 -  subplot(3,1,2)
7 -  plot(t,x1,'g')
8 -  t1=0:0.0005:0.1;
9 -  x2=conv(x,x1)*0.0005;
10 -  subplot(3,1,3)
11 -  plot(t1,x2)
```



System Modeling and Simulation

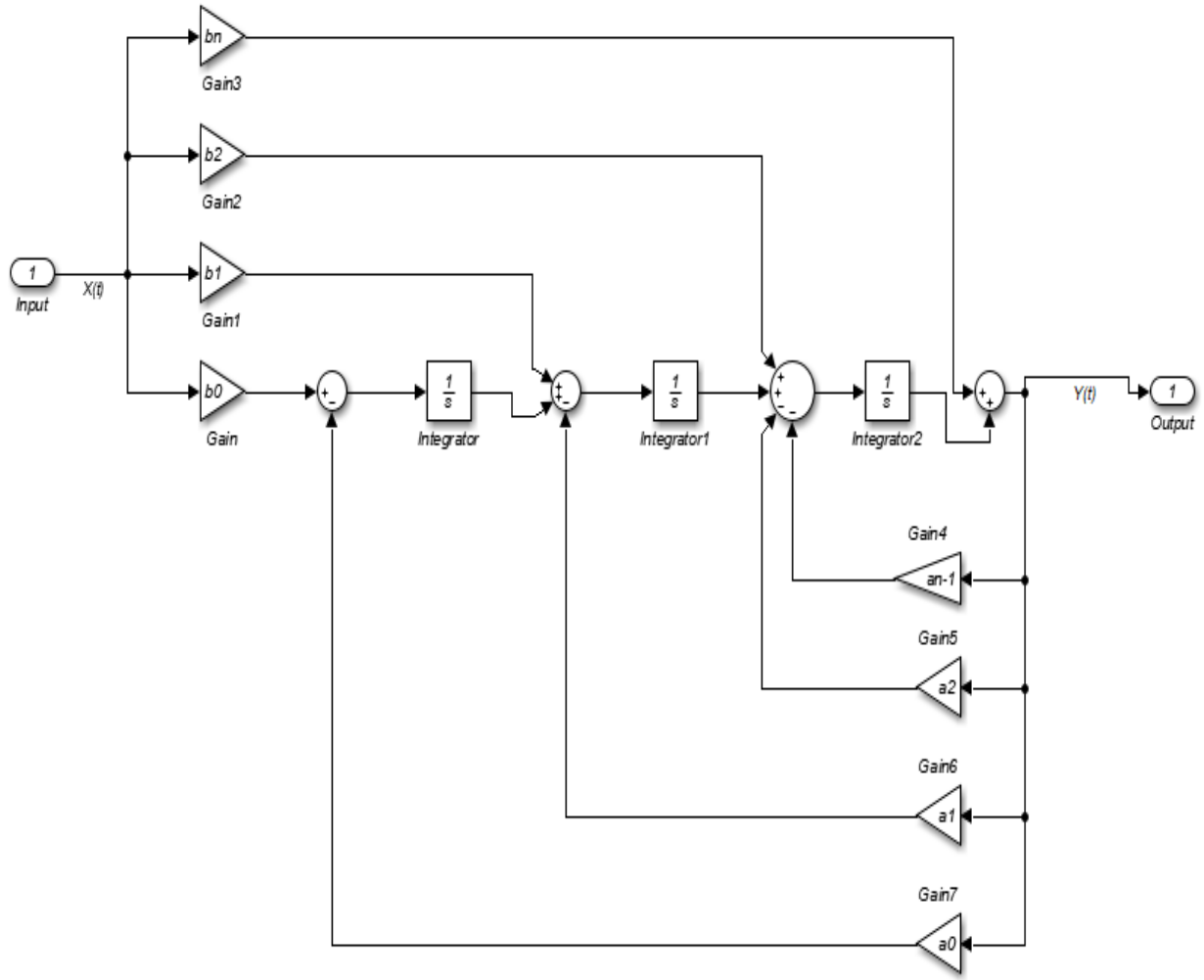
$$\frac{dny(t)}{dtn} + \sum_{i=0}^{n-1} \left(ai \frac{diy(t)}{dti}\right) = \sum_{i=0}^{n} \left(bi \frac{dix(t)}{dti}\right)$$

1- بنعمل على جعل معامل أكبر قوة بال output يساوي1.

2-فصل ال output عن ال input .

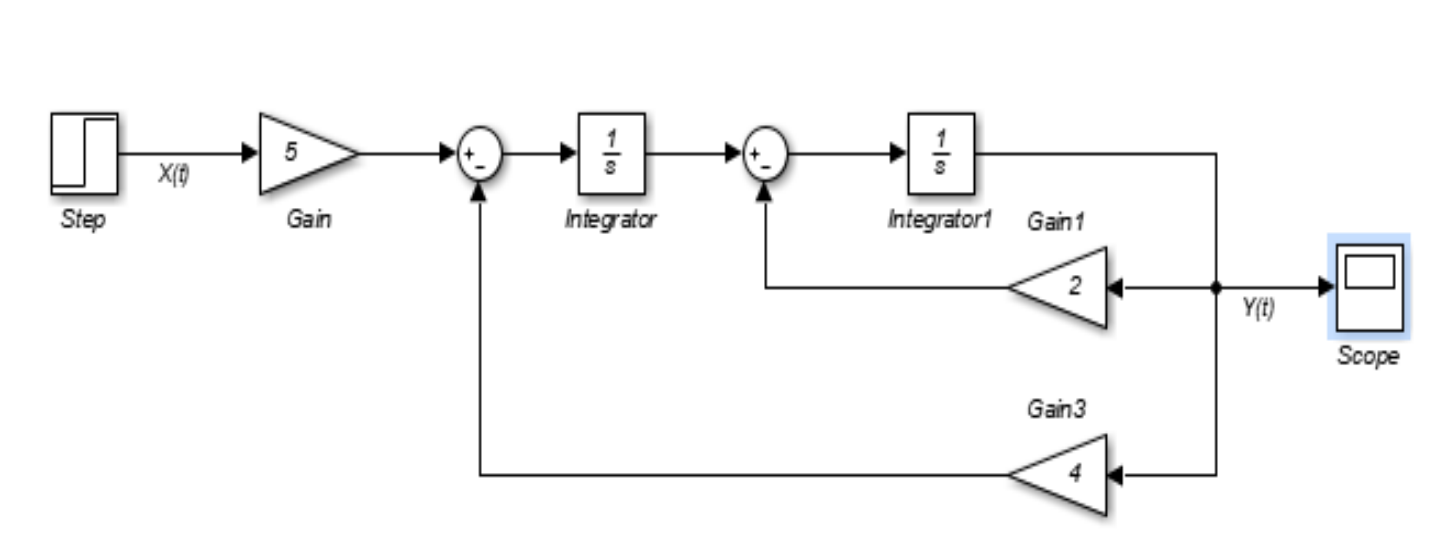
3- حل المشتقة بال s-domain هو عبارة عن تكامل المشتقة، لذلك بنستخدم بلوك integrator.

4- حل المشتقة بال time domain بنستخدم بلوك التكامل.



System Modeling and Simulation

$d2y(t)/dt2 + 2dy/dt + 4y(t) = 5\,x(t)$ **Simulation in S-domain:**



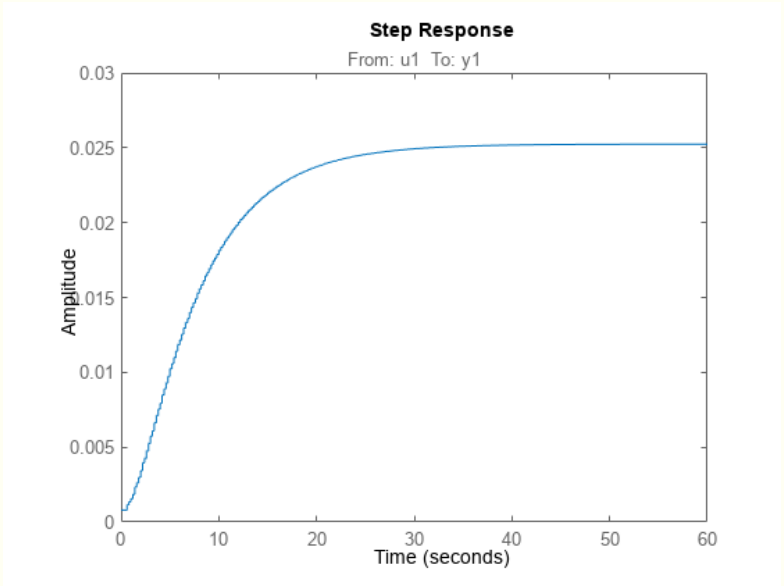
Step response & semi log scale functions

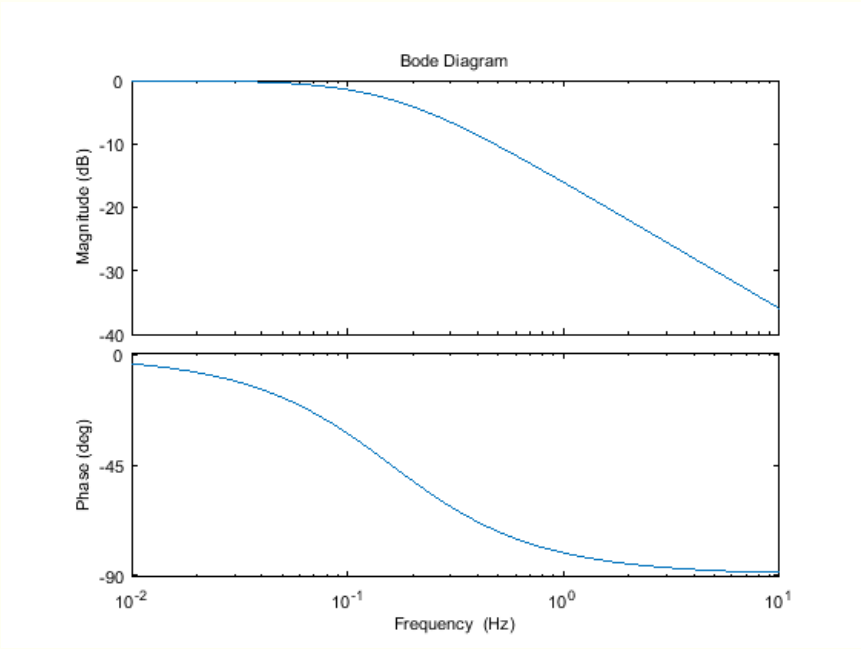
To plot the step response in matlab we use command **step.**

Ex : step(sys,t)

To plot the frequency response in matlab we use command **bode**.

Ex: bode(sys)





Spectrum Plotting

To find the fourrier transform we use command **`fourier(y).`**

To plot the spectrum you need to define a suitable number of samples and the sample rate (fs , n).

Apply Fast Fourier transform by using command **`fft(y).`**

Then plot the signal in spectral representation using command **`plot.`**

Laplace and Inverse Laplace

To compute the laplace transform you should define the function, then use command **`Laplace(function).`**

To compute the inverse laplace transform you should define the function, then use command **`ilaplace(function).`**

GOOD LUCK

Eng. Rafah Rahhal