Faculty of Engineering and Technology Electrical and Computer Engineering Department

ENEE2312Signals and Systems

MATLAB _Assignment

Prepared by:

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Inst.: Dr. Jamal Siam

Question I: Generate and plot the following signals using MATLAB:

1.1. X1(t) = u(t-5)- u(t-11)

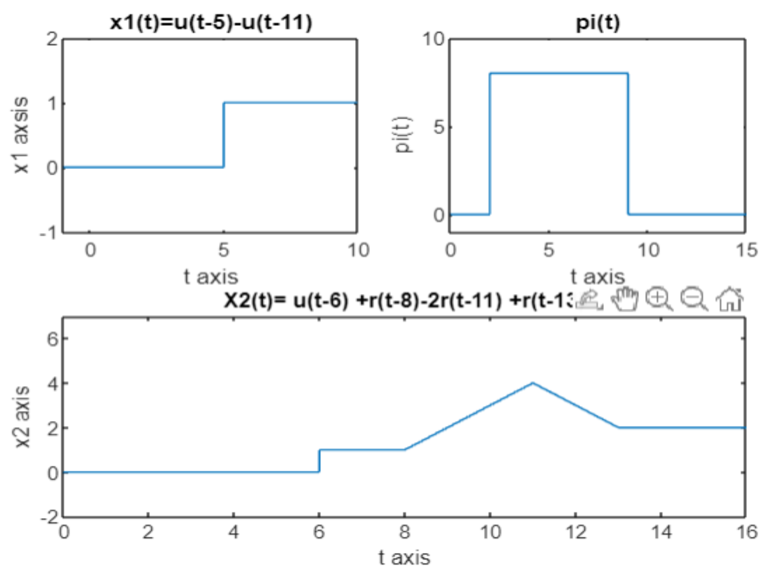
1.2. A finite pulse (π(t)) with value = 8 and extension between 2 and 9

1.3. X2(t)= u(t-6) +r(t-8)-2r(t-11) +r(t-13) in the time interval [0 18]

Code:

```
syms t x1 pi x2;
%1
x1=heaviside(t-5)-heaviside(t-11);
subplot(2,2,1);
fplot(x1);
xlabel("t axis");
ylabel("x1 axsis");
title("x1(t)=u(t-5)-u(t-11)");
axis([-1 10 -1 2]);
%2
pi= 8*rectangularPulse(2,9,t);

subplot(2,2,2);
fplot(pi);
xlabel("t axis");
ylabel("pi(t)");
title("pi(t)");
axis([0 15 -1 10]);

%3
x2=heaviside(t-6)+(t-8)*heaviside(t-8)-2.*(t-11)*heaviside(t-11)+(t-13)*heaviside(t-13);
subplot(2,2,[3 4]);
fplot(x2);
xlabel("t axis");
ylabel("x2 axis");
title("X2(t)= u(t-6) +r(t-8)-2r(t-11) +r(t-13)");
axis([0 16 -2 7]);
```

Output:



Question II:

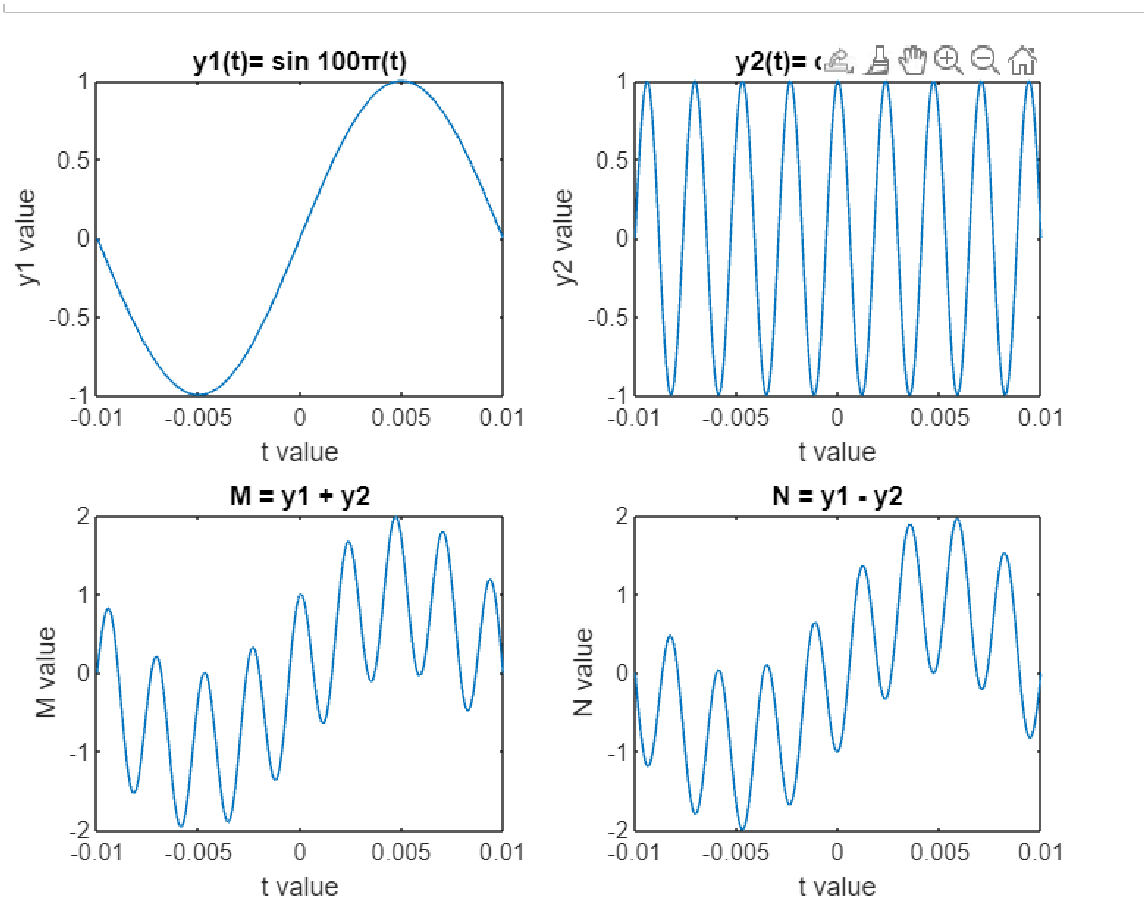
1. Generate and plot the signals y1(t)= sin 100π(t), y2(t)= cos850πt, then determine y1 and plot the signals m(t)= y1+y2 and n(t)= y1-y2

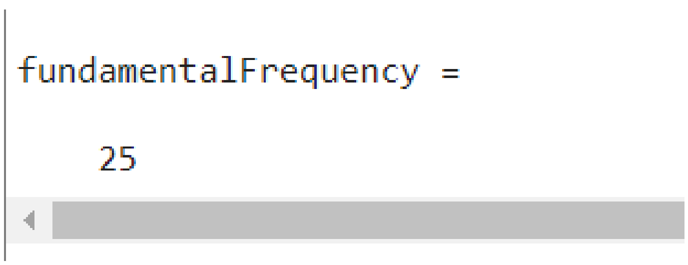
2. Determine, using the MATLAB plots, if the sum and/or difference signals are periodic. In case a signal is periodic, determine its fundamental frequency.

Code:

```
syms t y1 y2 M N;
t=-0.01:0.00001:0.01;
y1 = sin(100*pi*t);
subplot(2,2,1);
plot(t,y1);
xlabel("t value");
ylabel("y1 value");
title("y1(t)= sin 100π(t)");

y2 = cos(850*pi*t);
subplot(2,2,2);
plot(t,y2);
xlabel("t value");
ylabel("y2 value");
title("y2(t)= cos 850πt");

M = y1 + y2;
subplot(2,2,3);
plot(t,M);
xlabel("t value");
ylabel("M value");
title("M = y1 + y2");

N = y1 - y2;
subplot(2,2,4);
plot(t,N);
xlabel("t value");
ylabel("N value");
title("N = y1 - y2");

Fr1 = (100*pi)/(2*pi);
Fr1 = round(Fr1); % convert Fr1 to integer
Fr2 = (850*pi)/(2*pi);
Fr2 = round(Fr2); % convert Fr2 to integer
fundamentalFrequency = gcd(Fr1,Fr2)
```

Output:





Question III: Write the programs that solve the following differential equations using zero initial conditions.

1. 15 dy(t) /dt + 30y(t) = 10

Code:

```
syms y(t)
D2=diff(y)
D3=y(0)==0;
x=(15*D2)+(30*y)==10;
dsolve(x, D3)
```

Output:

```
Command Window

ans =

1/3 - exp(-2*t)/3

>>
```

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2. **d 2y(t) dt 2 + 8 dy dt + 25y(t) = 5 cos(1200t)**

code:

```
syms y(t)
D2=diff(y,2);
D3=diff(y);
D4=y(0)==0;
x=(D2)+(8*D3)+ 25*y == 5*cos(1200*t);
 dsolve(x, D4)
```

Output:

ans =

sin(3*t)*((2*cos(1197*t))/859695 + (2*cos(1203*t))/868335 + (399*sin(1197*t))/573130 + (401*sin(1203*t))/578890) - cos(3*t)*((399*cos(1197*t))/573130 - (401*cos(1203*t))/578890 - (2*sin(1197*t))/859695 + (2*sin(1203*t))/868335) + (57599*cos(3*t)*exp(-4*t))/16588961285 - C1*sin(3*t)*exp(-4*t)

Question IV: Write the programs that determine the response of the linear time invariant system to the given input and the given initial conditions:

1. **dy(t) dt + 6y(t) = 20u(t) $y(0) = 2$;**

code:

```
syms y(t)
D2=diff(y);
D3=y(0)==2;
x=(D2)+(6*y) == 20*heaviside(t);
 dsolve(x, D3)
```

Output:

```
ans =

exp(-6*t)/3 - exp(-6*t)*((5*sign(t))/3 - (5*exp(6*t)*(sign(t) + 1))/3)

``
```

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2. d 2y(t) dt 2 + 2 dy dt + 2y(t) = 10cos(2000t) (y (0) =2, y' (0) =4);

code:

```
syms y(t)
D2 = diff(y,2);
D3 = y(0) == 2;
D4 = diff(y);
D5 = D4(0) == 4;
x = (D2) + (2*D4) + (2*y) == 10*cos(2000*t);
sol = dsolve(x,D3 ,D5)
```

Output:

>> sol =

sin(t)*((5*cos(1999*t))/3996002 + (5*cos(2001*t))/4004002 + (9995*sin(1999*t))/3996002 + (10005*sin(2001*t))/4004002) - cos(t)*((9995*cos(1999*t))/3996002 - (10005*cos(2001*t))/40040

Question V: Use Simulink (MATLAB) to simulate the following systems then show and plot the step response of the system.

1. ***d*** **4*y*(*t*) /*dt* 4 + 8 *dy*(*t*) /*dt* + 6*y*(*t*) = 7 *d* 2*x*(*t*)/ *dt* 2 + 12*x*(*t*)**

Q5

① $\frac{d^4y}{dt^4} + 8\frac{dy(t)}{dt} + 6y(t) = 7\frac{d^2x(t)}{dt^2} + 12x(t)$

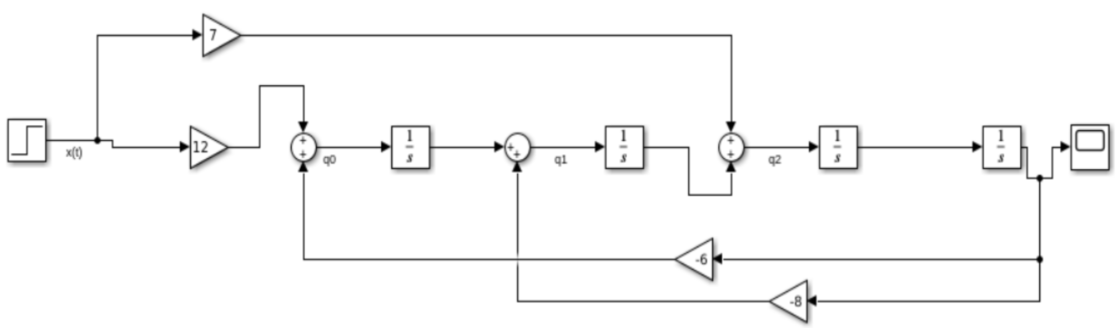
$\int \frac{d^4y}{dt^4} + 8\frac{dy(t)}{dt} + \cancel{7}\frac{d^2x(t)}{dt^2} = \int 12x(t) - 6y(t) = q_0$

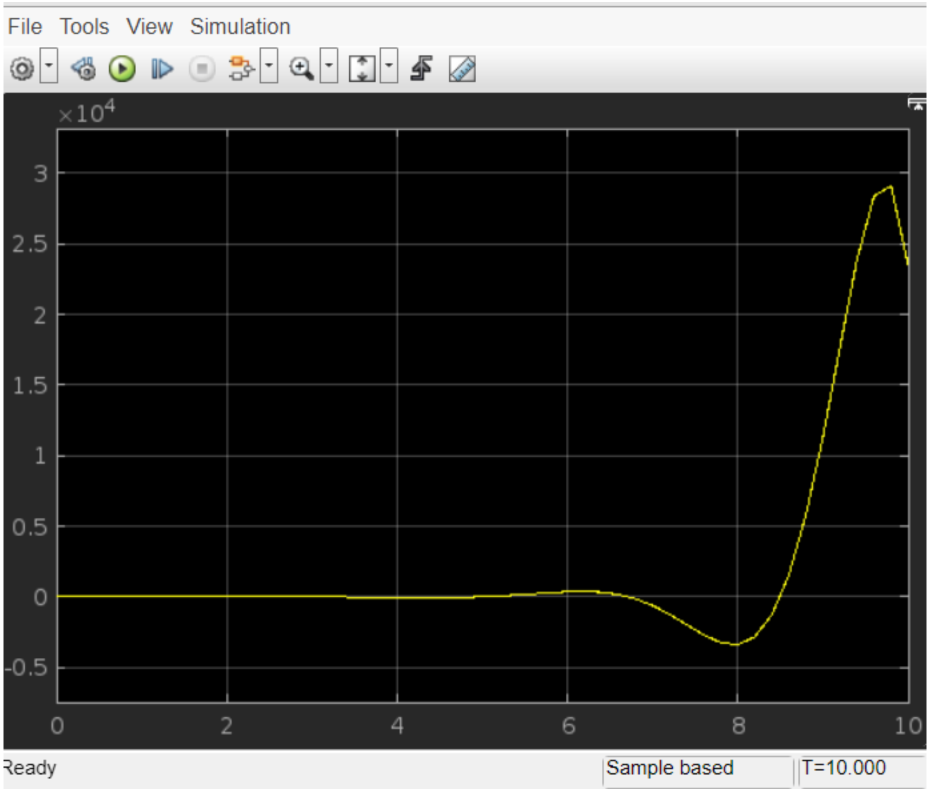
$\int \frac{d^3y}{dt^3} + 8y - 8y(t) - 7\frac{dx(t)}{dt} = \underbrace{\int q_0 - \int 8y(t)}_{q_1}$

$\int \frac{d^2y}{dt^2} = \underbrace{\int q_1 + 7x(t)}_{q_2}$

$\int \frac{dy(t)}{d(t)} = \int q_2$

$y(t) = \int q_2$





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2. **d 3y(t)/ dt 3 + 2 dy/ dt + 4y(t) = 5 $x(t)$:**

$\boxed{2}$

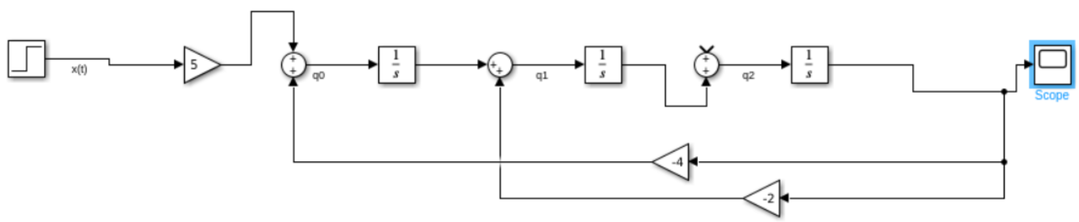
$$\frac{d^3y(t)}{dt^3} + 2\frac{dy}{dt} + 4y(t) = 5x(t)$$

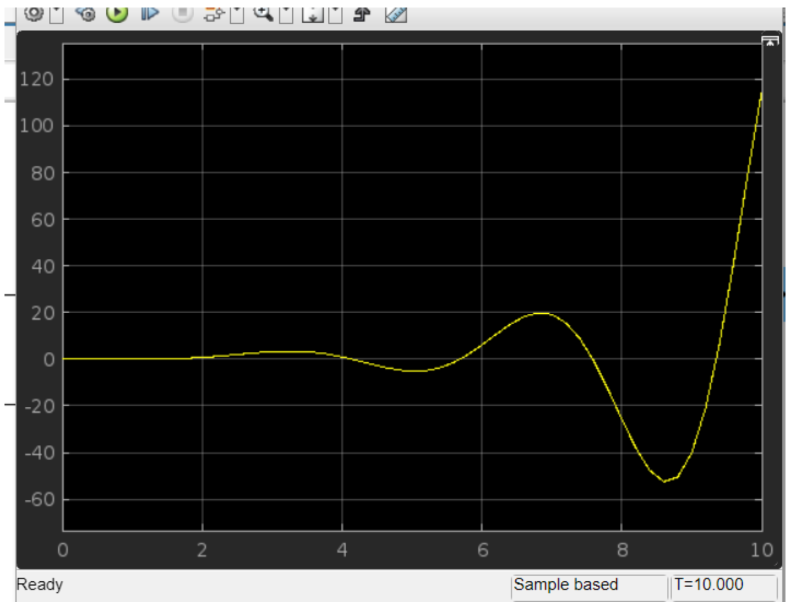
$$\int \frac{d^3y(t)}{dt^3} + 2\frac{dy}{dt} = \int \underbrace{5x(t) - 4y(t)}_{q_0}$$

$$\int \frac{d^2y(t)}{dt^2} = \int \underbrace{q_0 - 2y(t)}_{q_1}$$

$$\int \frac{dy(t)}{dt} = \int \underbrace{q_1}_{q_2}$$

$$y(t) = -q_2$$





Question VI: Write a program that computes and plots the convolution of the functions :

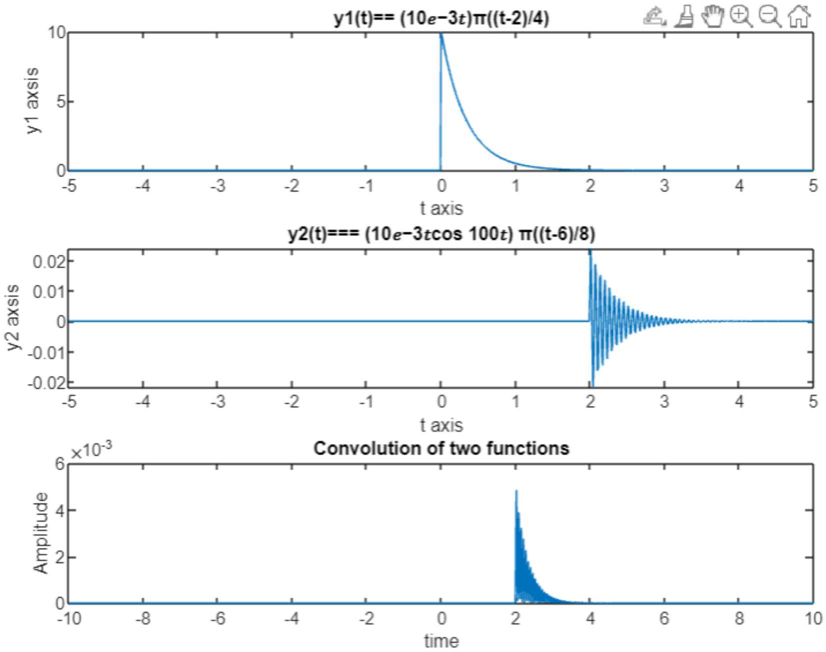
$y(t) = (10e -3t)\pi((t-2)/4)$, $y(t) = (10e -3t \cos 100t)\ \pi((t-6)/8)$

The code:

```
t = -5:0.01:5;

y1 = 10 * exp(-3 * t) .* rectpuls ( (t - 2) / 4); % Define the first function
subplot(3,1,1);
plot(t,y1);
xlabel("t axis");
ylabel("y1 axsis");
title("y1(t)== (10e−3t)π((t-2)/4)");
y2 = 10 * exp(-3 * t) .* cos(100 * t) .* rectpuls ( (t - 6) / 8); % Define the second function
subplot(3,1,2);
plot(t,y2);
xlabel("t axis");
ylabel("y2 axsis");
title("y2(t)=== (10e−3tcos 100t) π((t-6)/8)");
y_conv = conv(y1, y2) * 0.01; % Compute the convolution
t_conv = -10:0.01:10; % Define the time range for convolution
subplot(3,1,3);
plot(t_conv,y_conv);
xlabel('time');
ylabel('Amplitude');
title('Convolution of two functions');
```

The output:


y1(t)== (10e−3t)π((t-2)/4)
y1 axsis
t axis
y2(t)=== (10e−3tcos 100t) π((t-6)/8)
y2 axsis
t axis
Convolution of two functions
Amplitude
time