DSP UESTC 4005: Homework #1

Due on 23:59:59 March 17, 2019 at 23:59:59

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Problem 1

2.7
Solution
MATLAB code:

```
X1n=[1 0 1 0 1 0 1 0 1 0 1 0 1 0 1];
X2n=[1 1];
X3n=[1 1 0 0 0 0 0 0 1 1];
X4n=[1 0 1 0 1 0 1];
y1=conv(X1n,X2n);
y2=conv(X3n,X4n);
```

Thus we can see the same result of both y1 and y2–y1=y2=[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1]

Problem 2

2.8

Solution

MATLAB code:

```
x1n=[1 -1 1];
x2n=[1 -1 0 1 -1];
x3n=[-1 2 0 -2 1];
y1=conv(x1n,x1n);
y2=conv(x2n,x2n);
y3=conv(x3n,x3n);
```

Problem 3

2.13

Solution

y[-1]=

$$\sum_{i=-\infty}^{\infty} x_[i] \times h_[1-i]$$

=x[0]h[1]+x[1]h[0] + x[2]h[-1]

= -31

we could derive equations above via the definition of the convolution sum,
and once the n=-1, then the equations is y[-1]=

$$\sum_{i=-\infty}^{\infty} x_[i] \times h_[1-i] ,$$

compared with y[n]=

$$\sum_{i=-\infty}^{\infty} x_[i] \times h_[n-i] ,$$

Problem 4

2.23

Solution if $\sum_{i=-\infty}^{\infty} |x_[i]|$ is smaller than infinity, then it is obvious that the series is bounded to a specific finite number.

2.30

Solution

a)=$\sum\limits_{i=1}^{\infty} |\alpha^n|$

=$\sum\limits_{i=1}^{\infty} |\alpha|^n$

=$\frac{|\alpha|}{1-|\alpha|}$

so, the sum is finite when absolute alpha is smaller than 1 .

b)=$\sum\limits_{i=1}^{\infty} |n\alpha^n|$

=$\sum\limits_{i=1}^{\infty} n|\alpha|^n$

=$\frac{|\alpha|}{(1-|\alpha|)^2}$

$\frac{|\alpha|}{(1-|\alpha|)^2}$

so, the sum is also finite when absolute alpha is also smaller 1.

c)=$\sum\limits_{i=1}^{\infty} |n^2\alpha^n|$

=$\sum\limits_{i=1}^{\infty} n^2|\alpha|^n$

=$\frac{|\alpha|}{(1-|\alpha|)^2}$

=$(\frac{1}{1-|\alpha|})\sum\limits_{i=1}^{\infty}(2n-1)|\alpha|^n$

=$(\frac{1}{1-|\alpha|})(2 \times \sum\limits_{i=1}^{\infty} n|\alpha|^n \sum\limits_{i=1}^{\infty} |\alpha|^n\ )$

=$\frac{|\alpha|(1+|\alpha|)}{(1-|\alpha|)^3}$

so, the sum is also finite when absolute alpha is also smaller 1.

Problem 5

2.31

Solution

a)=$\sum\limits_{i=0}^{\infty} 0.25^n$

=4/3

so, the sum is finite when absolute alpha is smaller than 1 .

b)=$\sum\limits_{i=0}^{\infty} \frac{1}{(n+2)(n+3)}$

=$\sum\limits_{i=0}^{\infty} \frac{1}{(n+2)} - \frac{1}{(n+3)}$

=1/2

so, the sum is finite when absolute alpha is smaller than 1 .

Problem 6

2.38
Solution a)
A=$\sqrt{2}$
$\omega_0 = \pi/4$
$\phi = \pi/4$

b)
A=0.5
$\omega_0 = \pi/2$
$\phi = \pi/2$

c)
A=1
$\omega_0 = \pi/5$
$\phi = 0$

d)
A=2
$\omega_0 = \pi/4$
$\phi = \pi/2$

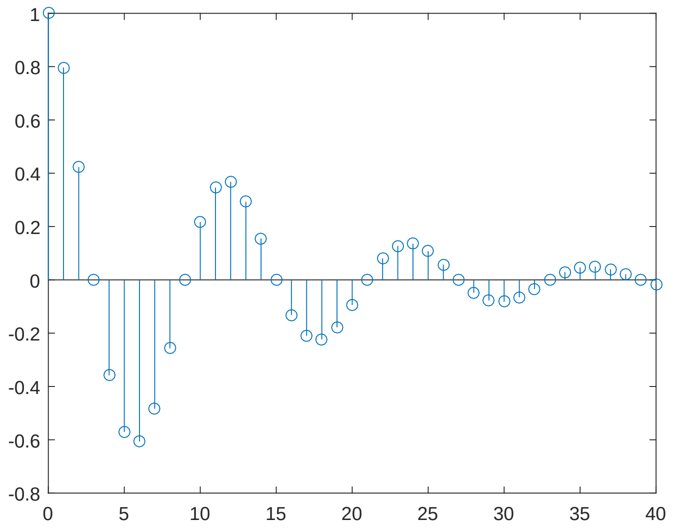

Figure 1: the real part

Problem 7

M2.2

Solution a) $n = [0 : 40];$

$xn = exp((1i * pi/6 - 1/12) * n);$

$real = real(xn);$

$im = imag(xn);$

$stem(n, im)$

$stem(n, real)$

$n = [0 : 30];$

$x1n = 0.2 * (1.2).^{n};$

$x2n = 20 * (0.9).^{n};$

$stem(n, x1n)$

$stem(n, x2n)$

b) $n = [0 : 82];$

$xn = (-2.7) * exp((1i * pi/6 - 0.4) * n);$

$stem(n, xn)$

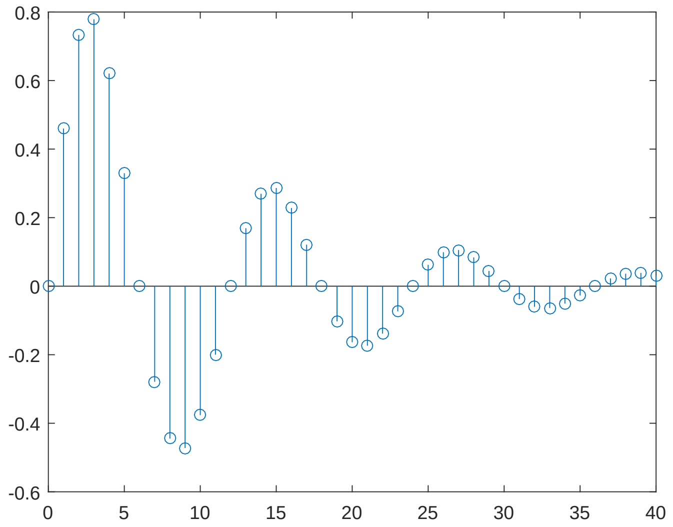

Figure 2: the imaginary part

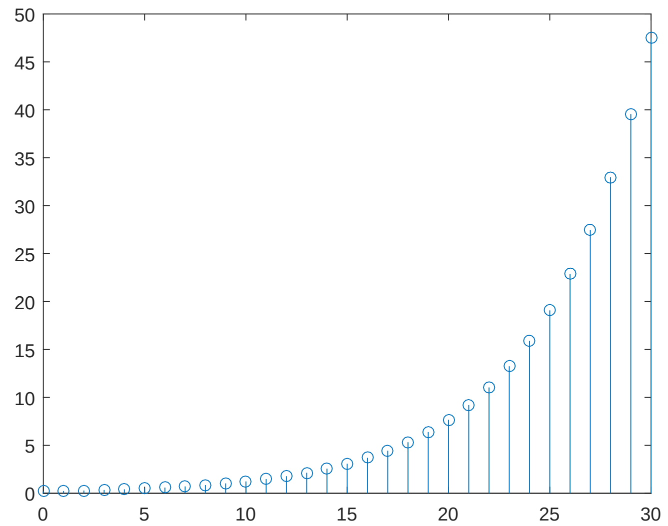

Figure 3: alpha=1.2

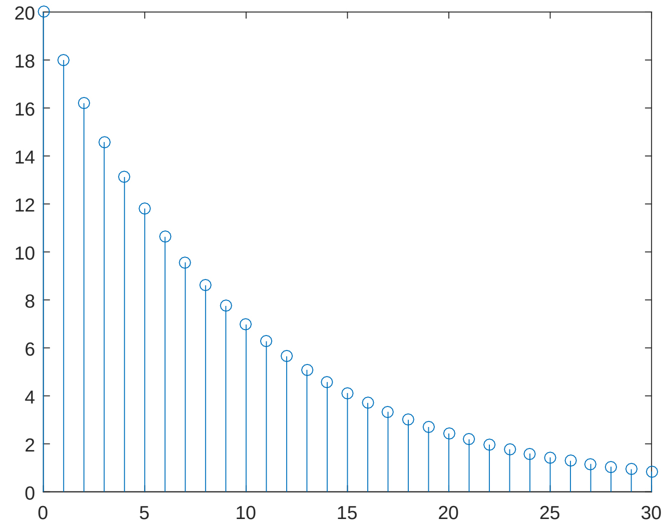

Figure 4: alpha=0.9

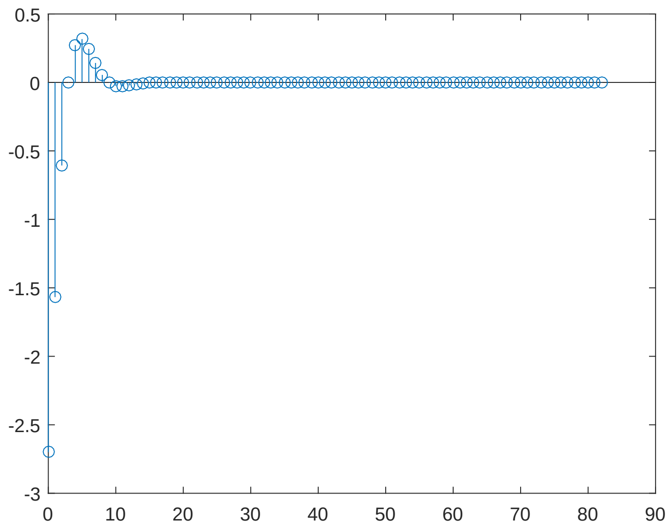

Figure 5: exponential sequence

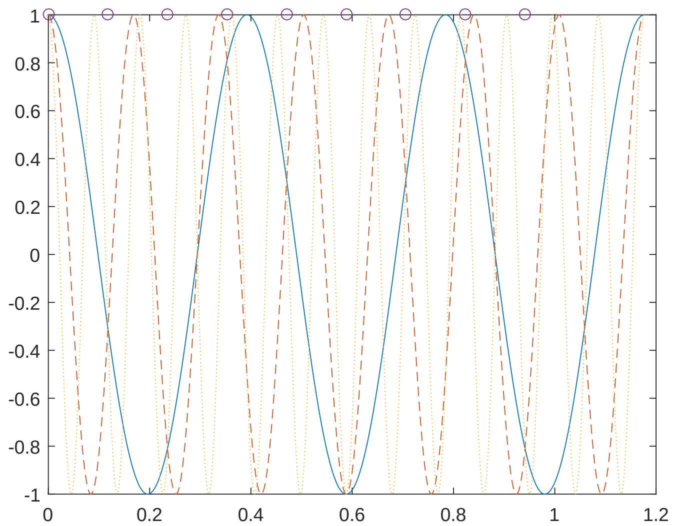

Figure 6: family sinusoidal

Problem 8

M2.7

Solution $t = 0 : 0.001 : 1;$

$g1 = cos(6 * pi * t);$

$g2 = cos(14 * pi * t);$

$g3 = cos(26 * pi * t);$

$plot(t/0.85, g1,' -', t/0.85, g2,' --', t/0.85, g3,' :');$

$hold$

$n = 0 : 1 : 8;$

$gs = cos(6 * pi * n);$

$plot(n/8.5, gs,' o');$

$holdoff$

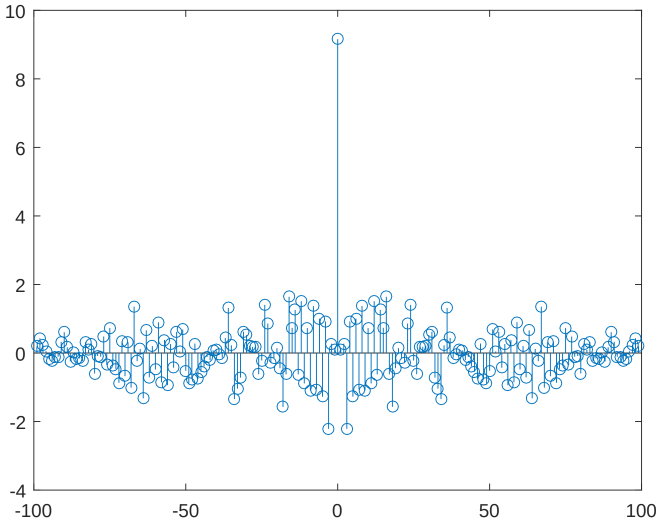

Figure 7: a peak at zero lag

Problem 9

M2.9

Solution $N = input('lengthofsequence =');$

$n = [0 : N - 1];$

$y1 = rand(1, N);$

$x = exp(-0.8 * n);$

$y = rand(1, N) - 0.5 + x;$

$n1 = length(x) - 1;$

$r = conv(y, fliplr(y));$

$k = (-n1) : n1;$

$stem(k, r)$