HW – 313288763 Rom Hirsch

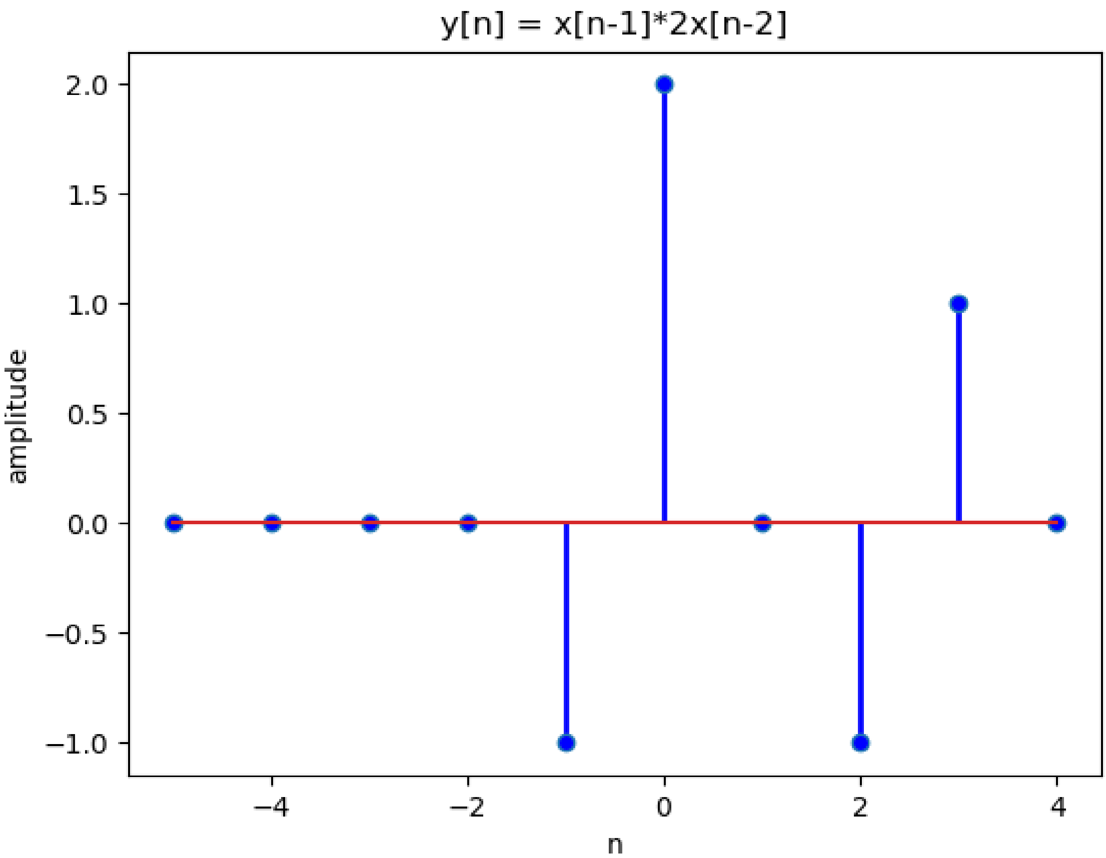
1.

Question 1:

$$h[n] = -\delta[n-1] + 2\delta[n-2]$$
$$x[n] = \delta[n+2] + \delta[n-1] + \delta[n-2]$$

$$y[n] = -x[n-1] + 2x[n-2]$$

ב.



קוד שאלה 1 ב.

```python
# -*- coding: utf-8 -*-
"""
Created on Mon Aug 30 14:17:59 2021

@author: rom21
"""
import matplotlib.pyplot as plt
from scipy import signal
import numpy as np

#%%
"""
Q -

x[n]=delta[n+2]+delta[n-1]+delta[n-2]
y[n]=-delta[n-1]+2delta[n-2]
"""

Vlen = 10 #len vector
#plot stem with color
def stem_plot(n,val,color):
    markerline1, stemlines1, baseline1 = plt.stem(n,val)
    plt.setp(markerline1, 'markerfacecolor', color)
    plt.setp(stemlines1, linestyle="-", color=color, linewidth=2 )


#create Delta
def dirac(val=0):
    zero = Vlen/2
    return signal.unit_impulse(Vlen,int(zero-val))

def plotStem(title,ylabel,xlabel,color,x,y):
    plt.figure()
    plt.title(title)
    plt.ylabel(ylabel)
    plt.xlabel(xlabel)
    stem_plot(x,y,color)
    plt.show()
#%%
n = np.arange(-5,5,1)
delta  = signal.unit_impulse(8)
x = dirac(2)+dirac(-1)+dirac(-2) # x[n]=delta[n+2]+delta[n-1]+delta[n-2]
h = -dirac(-1)+2*dirac(-2)
y=np.zeros(10)
yx = np.convolve(h,x)
for n in range(9):
    y[n]=-x[n-1]+2*x[n-2]
ncov =  np.arange(-5,5,1)
plotStem("y[n] = x[n-1]*2x[n-2]","amplitude","n",'blue',ncov,y)
```

Question 2:

$$y[n+2] = 2x[n] + 3x[n+1] + y[n+1] + 2y[n]$$

$$y[n] = 2x[n-2] + 3x[n-1] + y[n-1] + 2y[n-2]$$

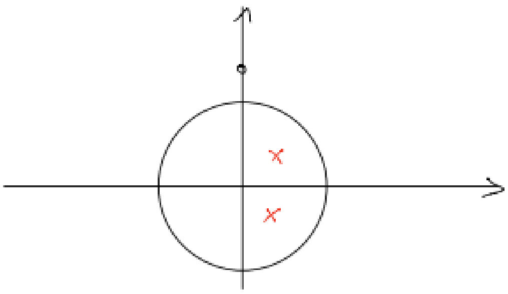
$$Y(z) = 2X(z)z^{-2} + 3X(z)z^{-1} + Y(z)z^{-1} + 2Y(z)z^{-2}$$

$$Y(z)\left(1 - z^{-1} - 2z^{-2}\right) = X(z)\left(2z^{-2} + 3z^{-1}\right)$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{3z+2}{z^2 - z - 2} = \frac{3\left(z + \frac{2}{3}\right)}{(z+1)(z-2)}$$

המערכת סיבתית כי יש 2 קטבים ואפס אחד

$$H(z) = \frac{2z - 3j}{2z^2 - 2z + 1} = \frac{z - \frac{3}{2}j}{z^2 - z + \frac{1}{2}} = \frac{z - \frac{3}{2}j}{\left(z - \left(\frac{1}{2} + \frac{1}{2}j\right)\right)\left(z - \frac{1}{2} - \frac{1}{2}j\right)}$$



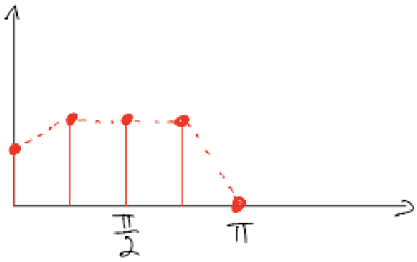
c.הקטבים בתוך מעגל היחידה לכן המערכת יציבה BIBO

d. יש אפס אחד לכן המערכת לא אוניטרית

e. המערכת רקורסיבית

Question 3:

DFT זה דגימה של DTFT לכן נקבל



$X[n] = [1,2,0,1,2]$

$h[n] = [1\ 2\ 2\ 1]$

$y[n] = x * h =$

$1[1\ 2\ 0\ 1\ 2\ 0\ 0\ 0\ 0]$

$+2\cdot[0\ 1\ 2\ 0\ 1\ 2\ 0\ 0]$

$+2[0\ 0\ 1\ 2\ 0\ 1\ 2\ 0]$

$+1[0\ 0\ 0\ 1\ 2\ 0\ 1\ 2]$

$=[1\ 2\ 6\ 6\ 6\ 6\ 5\ 2]$

כן אורך התגובה: $\overset{5}{m} + \overset{4}{n} - 1 = 8$

$$f[n] = [1 \ 2 \ 1]$$

$$F[k] = \sum_{n=0}^{2} f[n] e^{-j\frac{2\pi n k}{3}} = \overset{\overset{1}{\shortparallel}}{f[0]} + \overset{\overset{2}{\shortparallel}}{f[1]} e^{-j\frac{2\pi k}{3}} + \overset{\overset{1}{\shortparallel}}{f[2]} e^{-j\frac{4\pi k}{3}}$$

$$F[0] = 4$$

$$F[1] = 1 + 2e^{-j\frac{2\pi}{3}} + e^{-j\frac{4\pi}{3}}$$

$$F[2] = 1 + 2e^{-j\frac{4\pi}{3}} + e^{-j\frac{8\pi}{3}}$$