HW – 313288763 Rom Hirsch

.1

1.

$$H[z] = \sum_{n=-\infty}^{\infty} h[z] \cdot z^{-n} = \sum_{n=-\infty}^{\infty} (\delta[n] + 3\delta[n-1] + \delta[n-2] - h[n-1] - 0.2h[n-2]) z^{-n}$$

$$H(z) = 1 + 3z^{-1} + z^{-2} - H(z)z^{-1} - 0.2H(z)z^{-2}$$

$$H(z)(1 + z^{-1} + 0.2z^{-2}) = 1 + 3z^{-1} + z^{-2}$$

$$H(z) = \frac{1 + 3z^{-1} + z^{-2}}{1 + z^{-1} + 0.2z^{-2}} = \frac{z^2 + 3z + 1}{z^2 + z + 0.2} = \frac{(z+0.381)(z+2.618)}{(z+0.276)(z+0.723)}$$

.2

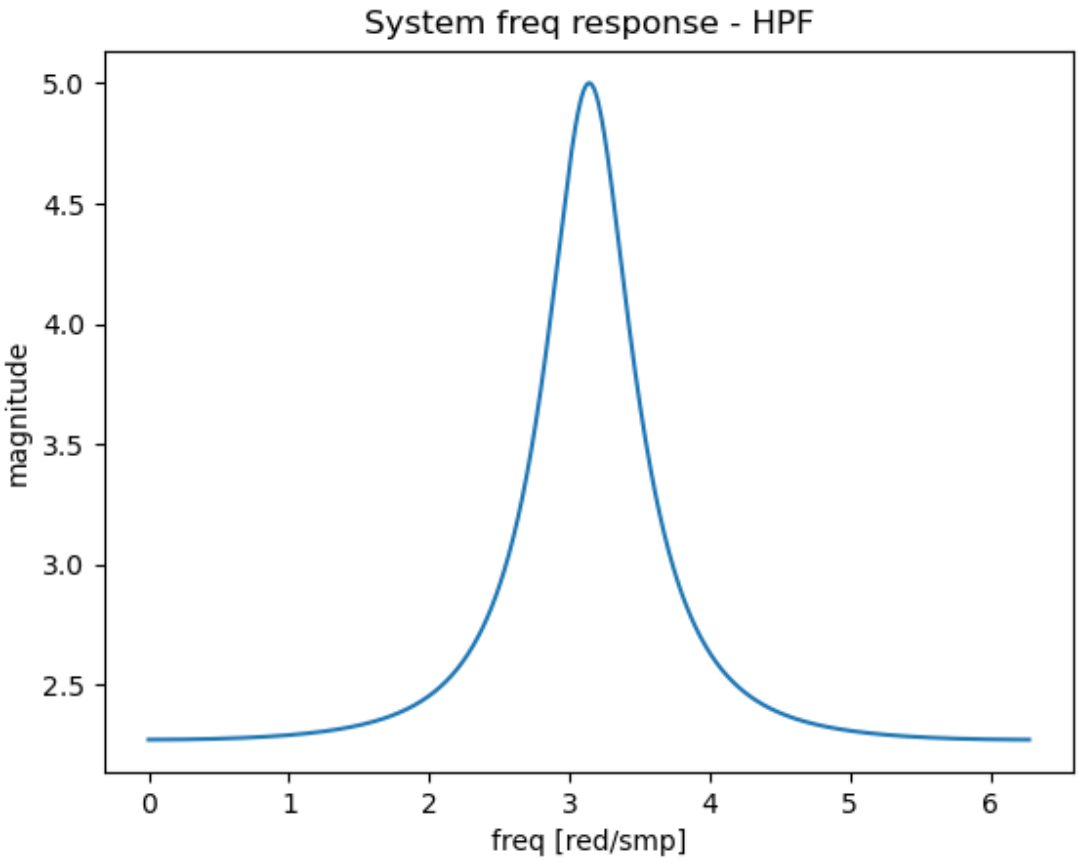
2.

אפסים : $-0.276, -0.723$

קטבים : $-0.381, -2.618$

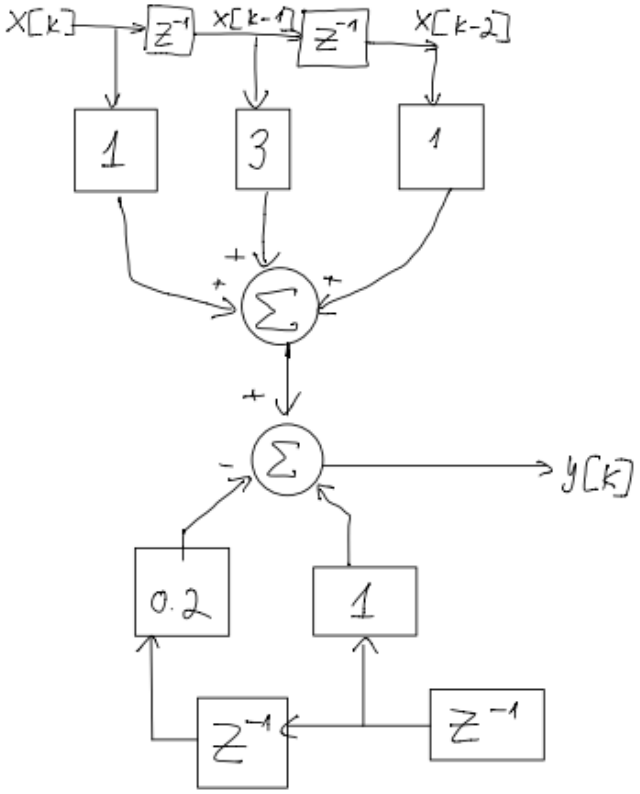
הקטבים במעגל היחידה ומספר הקטבים שווה למספר האפסים

לכן המערכת יציבה BIBO

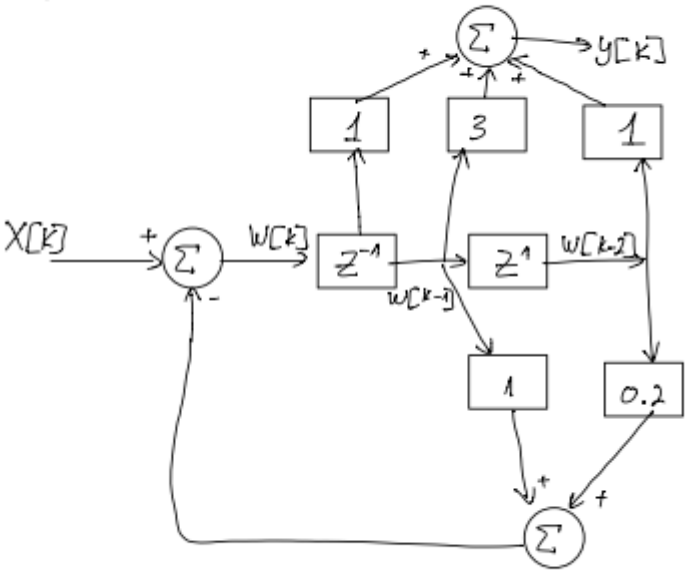

System freq response - HPF
5.0
4.5
4.0
3.5
3.0
2.5
magnitude
0
1
2
3
4
5
6
freq [red/smp]

4. $X[n] = 0.1^n \cdot u[n]$

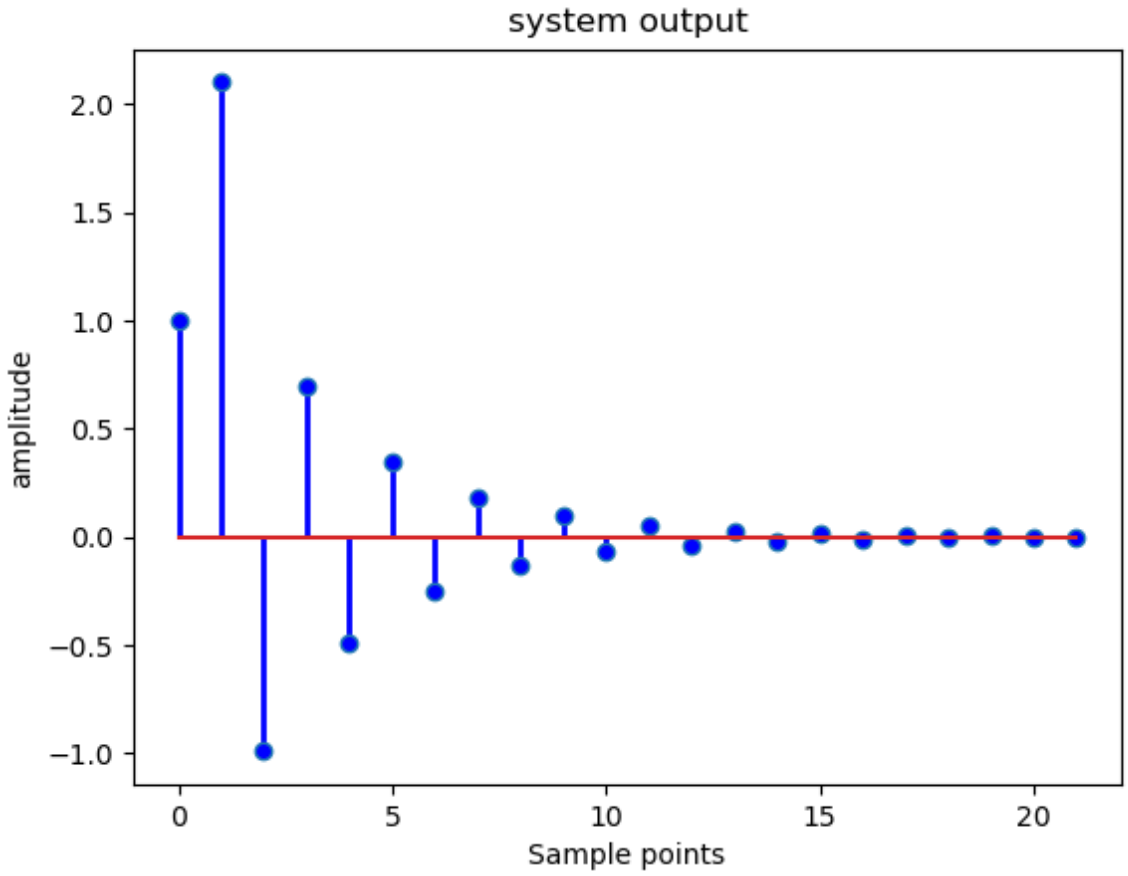
$y[n] = X[n] * H[n] = X[n] + 3X[n-1] + X[n-2] - y[n-1] + 0.2y[n-2]$



5.



6.להלן יציאת המערכת לכניסה x[k] בעורך 22 :



הקוד לשאלות 3 ו-6 בpython :

```
# -*- coding: utf-8 -*-
"""
Created on Mon Aug 23 10:41:33 2021

@author: rom21
"""


import scipy
import matplotlib.pyplot as plt
from scipy import signal
import numpy as np

#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 Stem plot with color
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()

#%%
"""

Q - 3

"""
w=np.arange(0,2*np.pi,2*np.pi/1000)
z=np.exp(1j*w)
H=(z**2+3*z+1)/(z**2+z+0.2)
plt.figure()
plt.title("System freq response - HPF")
plt.ylabel("magnitude")
plt.xlabel("freq [red/smp]")
plt.plot(w,abs(H))
plt.show()
#%% Q - 6
"""

Q - 6

"""
#X[n]
x  = np.ones(22)
for n in range(22):
    x[n]=0.1**n*x[n]

y = np.zeros(22)
y[0] = x[0]
y[1] = x[1] + 3*x[0] - y[0]
```

```
for n in range(2,22):
    y[n]=x[n]+3*x[n-1]+x[n-2]-y[n-1]-0.2*y[n-2]
plt.figure()
n = np.arange(len(y))#get the axis x for plot
plotStem("system output","amplitude","Sample points",'blue',n,y)
plt.show()
```