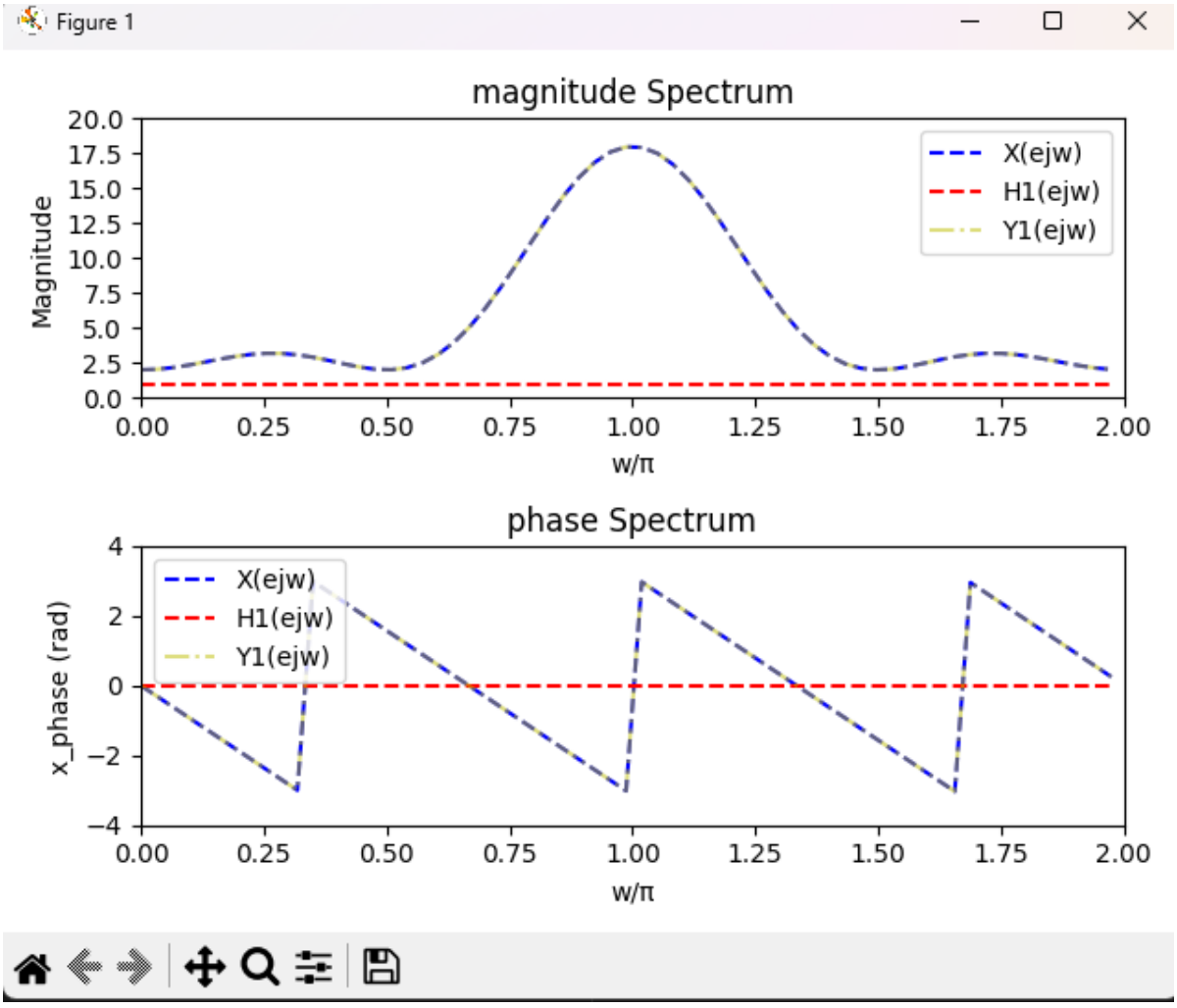
# HW3-2

## 第一部分

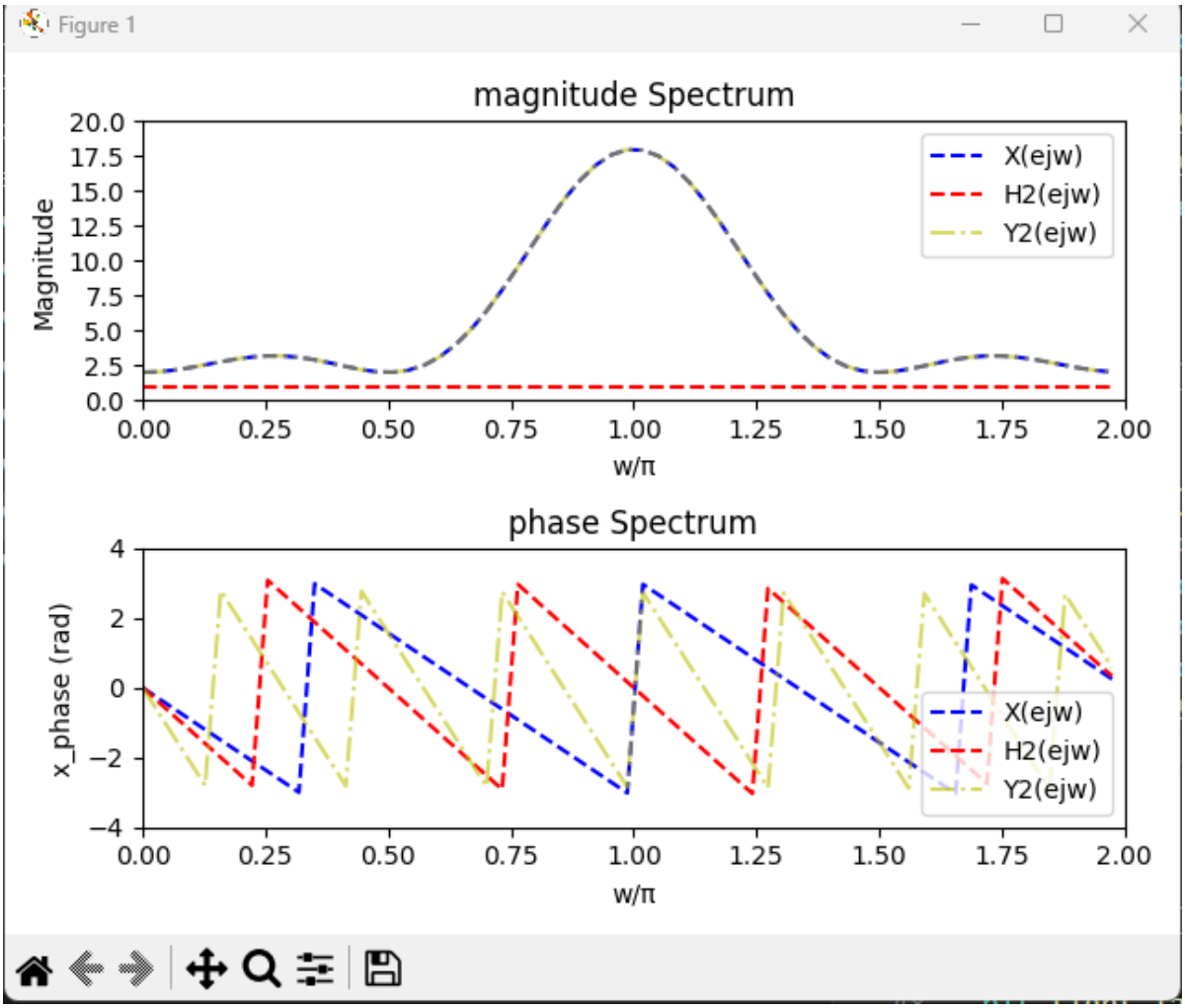
HW3-2(a)




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

pi=3.14
w = np.arange(0, 6.28, 0.1)

# 計算頻率響應
X_w =  np.exp(-3j * w)*(6-6*np.cos(w)+4*np.cos(2*w)-2*np.cos(3*w))
H_w=[1.0 for _ in range(63)]
Y_w=X_w*H_w

# 計算幅值響應
x_mag = np.abs(X_w)
H_mag=np.abs(H_w)
Y_mag=np.abs(Y_w)
# 計算相位響應
x_phase = np.angle(X_w)
H_phase = np.angle(H_w)
y_phase=np.angle(Y_w)
```

```
# 繪製幅值響應圖
plt.subplot(2,1,1)
plt.title('magnitude Spectrum')
plt.plot(w/pi, x_mag,linestyle='--', color='b')
plt.plot(w/pi, H_mag,linestyle='--', color='r')
plt.plot(w/pi, Y_mag,linestyle='-.', color='y',alpha=0.5)
plt.ylim(0,20)
plt.xlim(0,2)
plt.gca().yaxis.set_major_locator(plt.MultipleLocator(2.5))

plt.xlabel('w/π')
plt.ylabel('Magnitude')
plt.legend(['X(ejw)','H1(ejw)',"Y1(ejw)"])

# 繪製相位響應圖
plt.subplot(2,1,2)
plt.title('phase Spectrum')
plt.plot(w/pi, x_phase,linestyle='--', color='b')
plt.plot(w/pi, H_phase,linestyle='--', color='r')
plt.plot(w/pi, y_phase,linestyle='-.', color='y',alpha=0.5)
plt.xlim(0,2)
plt.ylim(-4,4)

plt.xlabel('w/π')
plt.ylabel('x_phase (rad)')
plt.legend(['X(ejw)','H1(ejw)',"Y1(ejw)"])

plt.tight_layout()
plt.show()
```

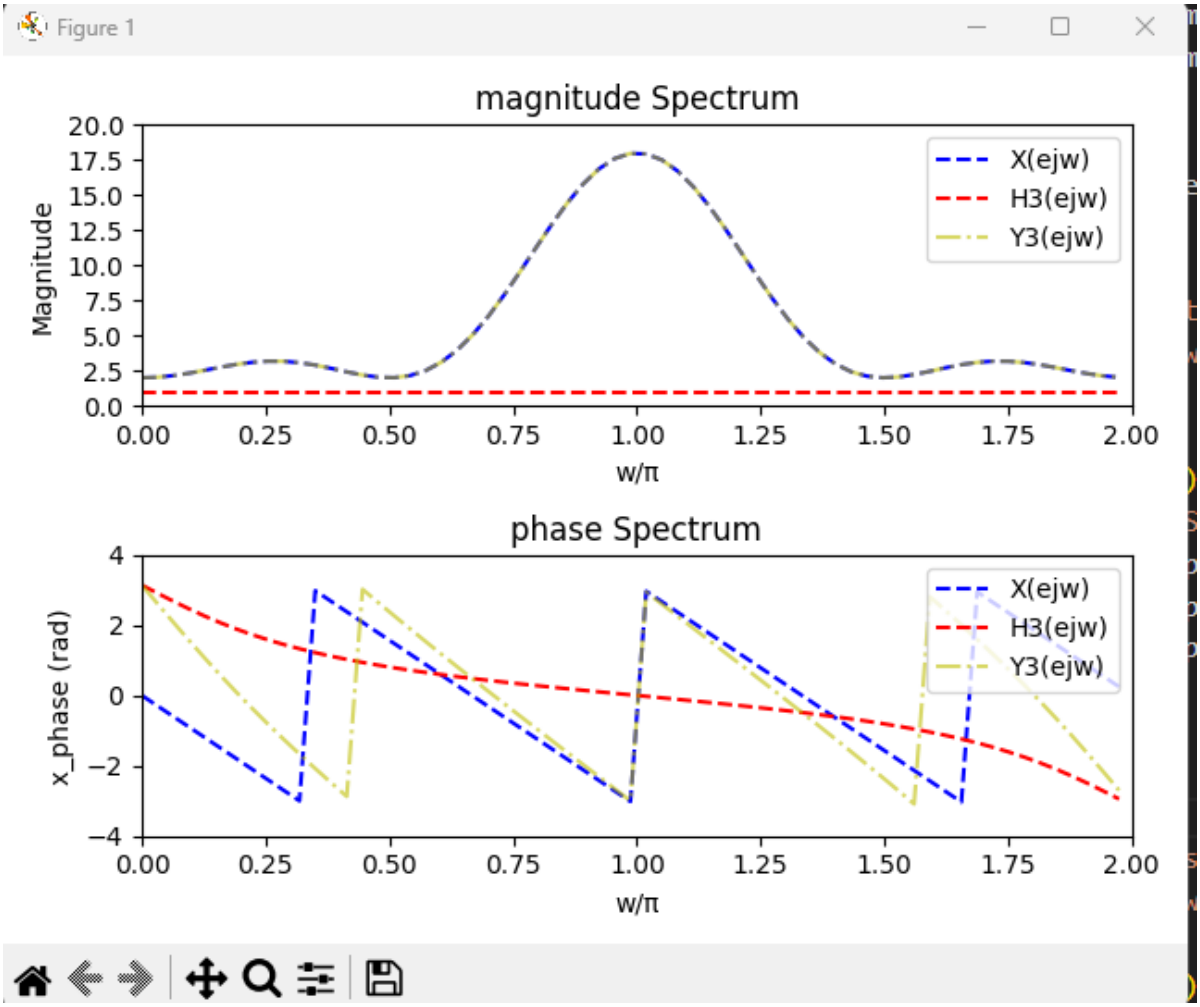
HW3-2(b)




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

pi=3.14
w = np.arange(0, 6.28, 0.1)

# 計算頻率響應
X_w =  np.exp(-3j * w)*(6-6*np.cos(w)+4*np.cos(2*w)-2*np.cos(3*w))
H_w=  np.exp(-4j * w)
Y_w=X_w*H_w
# 計算幅值響應
x_mag = np.abs(X_w)
H_mag=np.abs(H_w)
Y_mag=np.abs(Y_w)
# 計算相位響應
x_phase = np.angle(X_w)
H_phase = np.angle(H_w)
y_phase=np.angle(Y_w)
# y_phase=pi-y_phase
# 繪製幅值響應圖
plt.subplot(2,1,1)
plt.title('magnitude Spectrum')
plt.plot(w/pi, x_mag,linestyle='--', color='b')
plt.plot(w/pi, H_mag,linestyle='--', color='r')
plt.plot(w/pi, Y_mag,linestyle='-.', color='y',alpha=0.6)
plt.ylim(0,20)
```

```
plt.xlim(0,2)
plt.gca().yaxis.set_major_locator(plt.MultipleLocator(2.5))

plt.xlabel('w/π')
plt.ylabel('Magnitude')
plt.legend(['X(ejw)','H2(ejw)',"Y2(ejw)"])

# 繪製相位響應圖
plt.subplot(2,1,2)
plt.title('phase Spectrum')
plt.plot(w/pi, x_phase,linestyle='--', color='b')
plt.plot(w/pi, H_phase,linestyle='--', color='r')
plt.plot(w/pi, y_phase,linestyle='-.', color='y',alpha=0.6)
plt.xlim(0,2)
plt.ylim(-4,4)

plt.xlabel('w/π')
plt.ylabel('x_phase (rad)')
plt.legend(['X(ejw)','H2(ejw)',"Y2(ejw)"])

plt.tight_layout()
plt.show()
```

HW3-2(c)




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

```
pi=3.14
w = np.arange(0, 6.28, 0.1)

# 計算頻率響應
X_w =  np.exp(-3j * w)*(6-6*np.cos(w)+4*np.cos(2*w)-2*np.cos(3*w))
H_w=  (0.4-np.exp(-1.0j * w)) / (1.0-0.4*np.exp(-1.0j * w))
Y_w=X_w*H_w
# 計算幅值響應
x_mag = np.abs(X_w)
H_mag=np.abs(H_w)
Y_mag=np.abs(Y_w)
# 計算相位響應
x_phase = np.angle(X_w)
H_phase = np.angle(H_w)
y_phase=np.angle(Y_w)
# 繪製幅值響應圖
plt.subplot(2,1,1)
plt.title('magnitude Spectrum')
plt.plot(w/pi, x_mag,linestyle='--', color='b')
plt.plot(w/pi, H_mag,linestyle='--', color='r')
plt.plot(w/pi, Y_mag,linestyle='-.', color='y',alpha=0.6)
plt.ylim(0,20)
plt.xlim(0,2)
plt.gca().yaxis.set_major_locator(plt.MultipleLocator(2.5))

plt.xlabel('w/π')
plt.ylabel('Magnitude')
plt.legend(['X(ejw)','H3(ejw)',"Y3(ejw)"])

# 繪製相位響應圖
plt.subplot(2,1,2)
plt.title('phase Spectrum')
plt.plot(w/pi, x_phase,linestyle='--', color='b')
plt.plot(w/pi, H_phase,linestyle='--', color='r')
plt.plot(w/pi, y_phase,linestyle='-.', color='y',alpha=0.6)
plt.xlim(0,2)
plt.ylim(-4,4)

plt.xlabel('w/π')
plt.ylabel('x_phase (rad)')
plt.legend(['X(ejw)','H3(ejw)',"Y3(ejw)"])

plt.tight_layout()
plt.show()
```

# 第二部分

```
import scipy.signal
import numpy as np
input=np.array([-1,2,-3,6,-3,2,-1])
#轉移函數係數
#H1(z)=1
B1=[1.0]
A1=[1.0]
```

```
#H2(z)=z^-4
B2=[0,0,0,0,1.0]
A2=[1.0]
#H3(z)=(0.4-z^-1)/(1-0.4*z^-1)
B3=[0.4,-1.0]
A3=[1.0,-0.4]
filteredSignal1=scipy.signal.lfilter(B1,A1,input)
filteredSignal2=scipy.signal.lfilter(B2,A2,input)
filteredSignal3=scipy.signal.lfilter(B3,A3,input)
print("y1:",filteredSignal1)
print("y2:",filteredSignal2)
print("y3:",filteredSignal3)
```

```
X(n): [-1  2 -3  6 -3  2 -1]
y1(n): [-1.  2. -3.  6. -3.  2. -1.]
y2(n): [ 0.  0.  0.  0. -1.  2. -3.]
y3(n): [-0.4        1.64      -2.544      4.3824    -5.44704    1.621184
-1.7515264]
```

上述的知只有**y1(n)** 跟**x(n)**相同 ，其他皆不一樣。

因為在前**3**個作業中，頻率域中轉移函數雖然振幅大小皆為**1**，但是卻有不同的相位移，產生出不同的輸出結果