

Experiment No.

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Theoretical calculations:-

$$y[n] = \frac{1}{2}y[n-1] + x[n]$$

$$y[n] - \frac{1}{2}y[n-1] = x[n]$$

Taking ZT on either sides

$$Y(z) - \frac{1}{2}Y(z)z^{-1} = X(z)$$

$$Y(z) - \frac{1}{2}Y(z)z^{-1} = X(z)$$

$$Y(z)(1 - \frac{1}{2}z^{-1}) = X(z)$$

$$\frac{Y(z)}{X(z)} = \frac{1}{(1 - \frac{1}{2}z^{-1})}$$

We know that  $H(z) = \frac{Y(z)}{X(z)} = \frac{1}{(1 - \frac{1}{2}z^{-1})}$  — ①

Then Frequency response of system is obtained when  $z$  is replaced with  $e^{j\omega}$

$$H(e^{j\omega}) = \frac{1}{1 - \frac{1}{2}e^{-j\omega}} = \frac{1}{1 - \frac{1}{2}(\cos \omega - j \sin \omega)}$$

$$|H(e^{j\omega})| = \frac{1}{\sqrt{(1 - \frac{1}{2}\cos \omega)^2 + (\frac{1}{2}\sin \omega)^2}} \quad \text{--- ②}$$

By using ② we get magnitude response.

$$\angle H(e^{j\omega}) = -\tan^{-1}\left(\frac{\frac{1}{2}\sin \omega}{1 - \frac{1}{2}\cos \omega}\right) \quad \text{--- ③}$$

By using ③ we get phase response.



17 Write a program to find the frequency response, magnitude response and phase response when phase response of a system described by the difference equation also plot the poles and zero of a transfer function of the system.

$$\text{or } y[n] = 0.5y[n-1] + x[n]$$

```

clc
num = [1];
den = [1, -0.5];
figure(1);
zplane(num, den);
[h, omega] = freqz(num, den);
magh = abs(h);
ph = angle(h);
figure(2);
subplot(2,1,1); plot(omega, magh);
xlabel('omega'); ylabel('Mag');
title('Mag response');
subplot(2,1,2); plot(omega, ph);
xlabel('omega'); ylabel('phase');
title('Phase response');

```

Write a program to find the frequency  
 of each character in a string and print the  
 characters in descending order of frequency.  
 The different characters are not the same and  
 the order of the characters is not the same.

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



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Theoretical calculations:-

$$y[n] = x[n] - \frac{1}{4}x[n-1]$$

Taking ZT on either sides

$$\text{we get } Y(z) = X(z) - \frac{1}{4}X(z)Z^{-1}$$

$$Y(z) = X(z)\left(1 - \frac{1}{4}Z^{-1}\right)$$

$$\frac{Y(z)}{X(z)} = 1 - \frac{1}{4}Z^{-1}$$

$$\text{we know that } H(z) = \frac{Y(z)}{X(z)}$$

$$H(z) = 1 - \frac{1}{4}Z^{-1} \quad \text{--- (1)}$$

Then frequency response is obtained when  $Z$  is replaced with  $e^{j\omega}$ .

$$H(e^{j\omega}) = 1 - \frac{1}{4}e^{-j\omega} \quad \text{--- (2)}$$

Frequency of a system.  
response

$$|H(e^{j\omega})| = \sqrt{\left(1 - \frac{1}{4}\cos\omega\right)^2 + \left(\frac{1}{4}\sin\omega\right)^2} \quad \text{--- (3)}$$

Eqn (3) will give the magnitude response for different values of  $\omega$ .

$$\angle H(e^{j\omega}) = \tan^{-1}\left(\frac{\frac{1}{4}\sin\omega}{1 - \frac{1}{4}\cos\omega}\right) \quad \text{--- (4)}$$

Eqn (4) will give the phase response for different values of  $\omega$ .



$$b) y[n] = x[n] - \frac{1}{4}x[n-1]$$

clc

```
num = [1, -0.25];
```

```
den = [1];
```

```
figure(1);
```

```
zplane(num, den);
```

```
[h, omega] = freqz(num, den);
```

```
magn = abs(h);
```

```
ph = angle(h);
```

```
figure(2);
```

```
subplot(2,1,1); plot(omega, magn);
```

```
xlabel('omega'); ylabel('Mag');
```

```
title('Mag response');
```

```
subplot(2,1,2); plot(omega, ph);
```

```
xlabel('omega'); ylabel('phase');
```

```
title('Phase response');
```

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