



PROBLEM:

Consider the following MATLAB program:

```
nn = 0:16000;  
xx = 3 + 2*cos(0.75*pi*nn-pi/4) + 11*cos(1.5*pi*nn-pi/3);  
yy = conv([1,0,0,0,-1]/4,xx);  
soundsc(yy,8000)
```

- What is the system function $H(z)$ of the system that is implemented by the `conv()` statement?
- What is the frequency response of the system?
- Neglecting the end effects in the convolution, determine $y(t)$ that describes the signal produced by the `soundsc()` statement.



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(a) What is the system function $H(z)$ of the system that is implemented by the `conv()` statement?

The `conv()` statement represents the transfer function

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

(b) What is the frequency response of the system?

The frequency response is $H(e^{j\hat{\omega}}) = \frac{1}{2} \sin(2\hat{\omega}) e^{j\pi/2} e^{-j2\hat{\omega}}$

(c) Neglecting the end effects in the convolution, determine $y(t)$ that describes the signal produced by the `soundsc()` statement.

The final solution for $y(t)$ is

$$y[n] = \cos\left(\frac{3}{4}\pi n - \pi/4\right)$$

Now we use the sampling theorem to convert the discrete-time frequency of $\hat{\omega} = 3\pi/4$ to a frequency in hertz via:

$$f = \frac{\hat{\omega}}{2\pi} f_s = \left(\frac{3\pi/4}{2\pi}\right) 8000 \text{ Hz} = 3000 \text{ Hz}$$

and we get

$$y(t) = \cos(2\pi(3000)t - \pi/4)$$