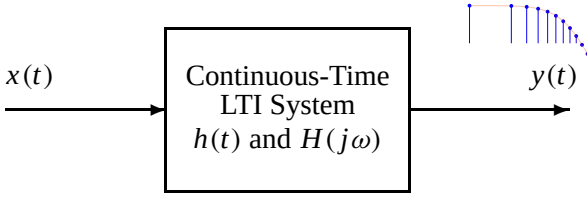
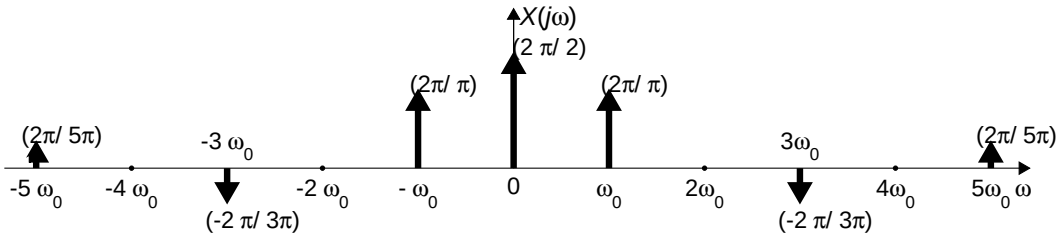
PROBLEM:



The periodic input to the above LTI system has the Fourier transform $X(j\omega)$ drawn below:



where the dark arrows denote impulses. For the following outputs of the system, determine from the list below the frequency response of the system that could have produced that output when the input is the signal with the given Fourier transform, $X(j\omega)$. [*Circle the correct answer. There is only one correct answer in each case.*]

(a) $y(t) = \frac{1}{2} + \frac{4}{3\pi}\cos(\omega_0 t)$ (1) (2) (3) (4) (5) (6)

(b) $y(t) = x(t-1) - \frac{1}{2}$ (1) (2) (3) (4) (5) (6)

(c) $y(t) = x(t-1)$ (1) (2) (3) (4) (5) (6)

(d) $y(t) = \frac{1}{\pi}\cos(\omega_0 t)$ (1) (2) (3) (4) (5) (6)

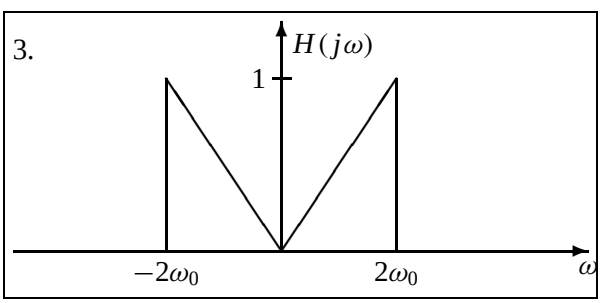
(e) $y(t) = 2(\omega_0/\pi)\cos(\omega_0 t + \pi/2)$ (1) (2) (3) (4) (5) (6)

The possible filters are described by the following equations and graphs.[1]

1. $H(j\omega) = \begin{cases} e^{-j\omega} & |\omega| < \omega_0/2 \\ 0 & |\omega| > \omega_0/2 \end{cases}$

2. $H(j\omega) = e^{-j\omega}$

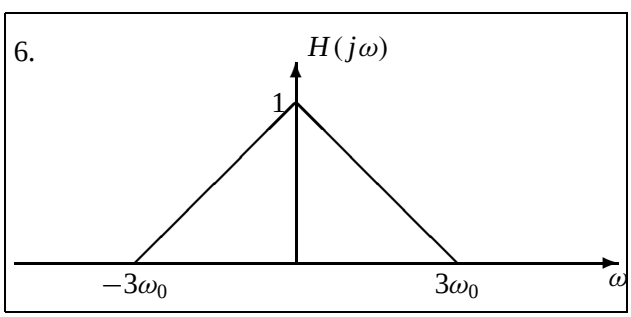
3.



4. $H(j\omega) = \begin{cases} j\omega & |\omega| < 3\omega_0/2 \\ 0 & |\omega| > 3\omega_0/2 \end{cases}$

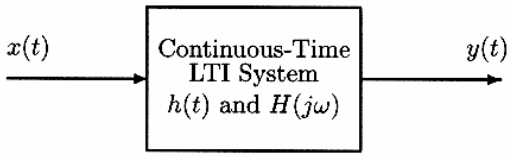
5. $H(j\omega) = \begin{cases} 0 & |\omega| < \omega_0/2 \\ e^{-j\omega} & |\omega| > \omega_0/2 \end{cases}$

6.

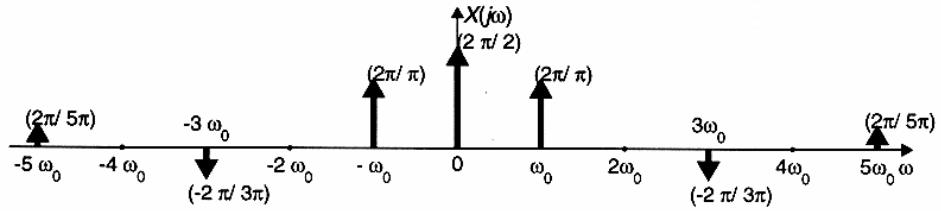


SOLUTION

[1] *Some of these may not be needed as answers.*



The periodic input to the above LTI system has the Fourier transform $X(j\omega)$ drawn below:



where the dark arrows denote impulses. For the following outputs of the system, determine from the list below the frequency response of the system that could have produced that output when the input is the signal with the given Fourier transform, $X(j\omega)$. [*Circle the correct answer. There is only one correct answer in each case.*]

(a) $y(t) = \frac{1}{2} + \frac{4}{3\pi}\cos(\omega_0 t)$	(1)	(2)	(3)	(4)	(5)	**(6)**
(b) $y(t) = x(t-1) - \frac{1}{2}$	(1)	(2)	(3)	(4)	**(5)**	(6)
(c) $y(t) = x(t-1)$	(1)	**(2)**	(3)	(4)	(5)	(6)
(d) $y(t) = \frac{1}{\pi}\cos(\omega_0 t)$	(1)	(2)	**(3)**	(4)	(5)	(6)
(e) $y(t) = 2(\omega_0/\pi)\cos(\omega_0 t + \pi/2)$	(1)	(2)	(3)	**(4)**	(5)	(6)

$j\omega_0 2\delta(\omega-\omega_0) - j\omega_0 2\delta(\omega+\omega_0)$

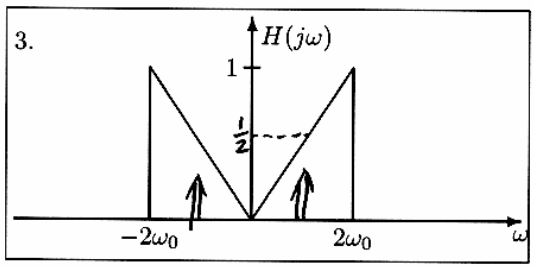
$\frac{2\omega_0}{\pi}\cos(\omega_0 t + \pi/2)$

The possible filters are described by the following equations and graphs.[3]

1. $H(j\omega) = \begin{cases} e^{-j\omega} & |\omega| < \omega_0/2 \\ 0 & |\omega| > \omega_0/2 \end{cases}$

2. $H(j\omega) = e^{-j\omega}$ Delay by 1

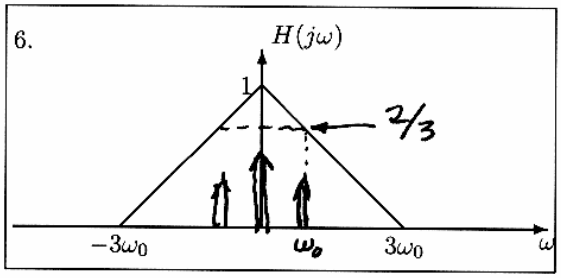
3.



4. $H(j\omega) = \begin{cases} j\omega & |\omega| < 3\omega_0/2 \\ 0 & |\omega| > 3\omega_0/2 \end{cases}$ $H(j0)=0$ $H(j\omega_0)=j\omega_0$

5. $H(j\omega) = \begin{cases} 0 & |\omega| < \omega_0/2 \\ e^{-j\omega} & |\omega| > \omega_0/2 \end{cases}$ Remove DC, Delay the rest

6.



[3] *Some of these may not be needed as answers.*

$\delta(\omega-\omega_0) + \delta(\omega+\omega_0)$

$\frac{1}{\pi}\cos(\omega_0 t)$

$\pi\delta(\omega) + \frac{4}{3}\delta(\omega-\omega_0) + \frac{4}{3}\delta(\omega+\omega_0)$

$\frac{1}{2} + \frac{4}{3\pi}\cos(\omega_0 t)$