

EECS20n, Quiz 4, 11/15/01

The quiz will take 15 minutes. Write your response on the sheet. Use the back if you need more space.

Please print your name here:

Last Name _____ First _____ Lab _____

Consider the continuous-time signal x where

$$\forall t \in \text{Reals}, \quad x(t) = 1 + \cos(\pi t) + \cos(2\pi t).$$

Suppose that x is the input to an LTI system with frequency response given by

$$\forall \omega \in \text{Reals}, \quad H(\omega) = \begin{cases} e^{i\omega} & \text{if } |\omega| < 4 \text{ radians/second} \\ 0 & \text{otherwise} \end{cases}$$

Find the output y of the system.

Solution:

Write x in terms of complex exponentials:

$$x(t) = e^{i0t} + 0.5e^{i\pi t} + 0.5e^{-i\pi t} + 0.5e^{i2\pi t} + 0.5e^{-i2\pi t},$$

and note that each term gets scaled by the frequency response,

$$y(t) = H(0)e^{i0t} + 0.5H(\pi)e^{i\pi t} + 0.5H(-\pi)e^{-i\pi t} + 0.5H(2\pi)e^{i2\pi t} + 0.5H(-2\pi)e^{-i2\pi t}.$$

Then note that $H(0) = 1$, $H(\pi) = -1$, $H(-\pi) = -1$, $H(2\pi) = 0$, and $H(-2\pi) = 0$, so

$$y(t) = 1 - \cos(\pi t).$$