

ECS 332: In-Class Exercise # 6

Instructions

1. Separate into groups of no more than three persons. **The group cannot be the same as any of your former groups.**
2. **Write down all the steps** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
3. "ENRP" = Explanation is not required for this problem.
"ENRPa" = Explanation is not required for this part.
4. **Do not panic.**

1. Consider an LTI communication channel.

Suppose when we put

$$x(t) = 2\cos(2\pi t) + 4\cos(4\pi t) + 6\cos(6\pi t) + 7\cos(8\pi t) + 1$$

into this channel, we get

$$y(t) = \cos(2\pi t) + \cos(4\pi t) + \sin(6\pi t) + 1 + 0\cos(8\pi t)$$

as its output.

a. Let $H(f)$ be the frequency response of the channel that satisfies the above input-output relation.

i. Find $H(2)$.

We have $4\cos(4\pi t) \rightarrow [H(f)] \rightarrow \cos(4\pi t)$
 $\Rightarrow H(-2) = H(2) = \frac{1}{4}$

ii. Find $H(4)$.

We have $7\cos(8\pi t) \rightarrow [H(f)] \rightarrow 0\cos(8\pi t)$
 $\Rightarrow H(-4) = H(4) = \frac{0}{7} = 0$

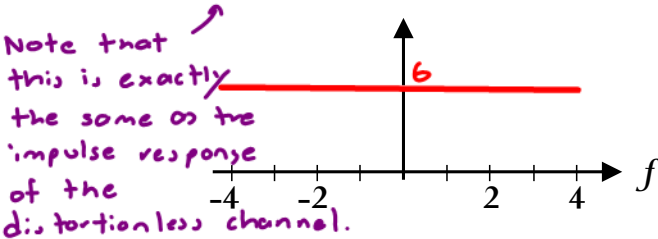
b. Is this channel distortionless?

$|H(2)| \neq |H(4)|$ so, we have amplitude distortion.
 The channel is **not** distortionless.

2. [ENRP] Consider each $g(t)$ defined below.

Let $G(f)$ be its Fourier transform. Plot $|G(f)|$ from $f = -4$ to $f = 4$ Hz.

(a) $g(t) = 6\delta(t-6)$



Recall that $\delta(t) \xrightarrow{\mathcal{F}} 1$ [Ex. 2.19]

From the time-shift property,

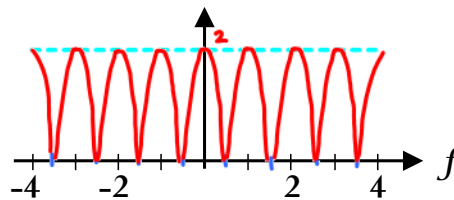
$$\delta(t-6) \xrightarrow{\mathcal{F}} (e^{-j2\pi(6)t})(1)$$

Therefore,

$$6\delta(t-6) \xrightarrow{\mathcal{F}} 6e^{-j2\pi(6)t}$$

note that the magnitude of this is 1

(b) (optional) $g(t) = \delta(t-6) + \delta(t-5)$



See the complete solution on the next page.

Date: **12/09** / 2018

Name

ID (last 3 digits)

Prapun

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