



► Pre-course Materials

► Topic 1: Course Overview

► Topic 2: Lossless Source Coding: Hamming Codes

► Topic 3: The Frequency Domain

► Topic 4: Lossy Source Coding

▼ Topic 5: Filters and the Frequency Response

5.1 Channels as Filters

**5.2 Frequency Response**

Week 3 Quiz due Nov 16, 2015 at 15:30 UTC

5.3 Filter Examples

Week 3 Quiz due Nov 16, 2015 at 15:30 UTC

5.4 Frequency Response of the IR Channel

Week 3 Quiz due Nov 16, 2015 at 15:30 UTC

Consider a linear time invariant channel with amplitude response

$$S(f) = \frac{0.2}{\sqrt{1.64 - 1.6 \cos(2\pi f)}}$$

and phase response

$$\theta(f) = \arctan\left(\frac{0.8 \sin(2\pi f)}{1 - 0.8 \cos(2\pi f)}\right)$$

### 5.2 QUIZ QUESTION 1 (1 point possible)

Suppose that the channel input has the form

$$x(n) = 2 \cos(2\pi \cdot 0.05n)$$

for all  $n$  from  $-\infty$  to  $+\infty$ . The channel output can be written as

$$y(n) = A \cos(2\pi \cdot 0.05n + \phi)$$

where  $-\pi \leq \phi \leq \pi$ .

What is the numerical value of  $A$  to two decimal places (e.g. 3.14)?

✖ Answer: 1.1629


#### EXPLANATION

The output amplitude ( $A$ ) is the amplitude of the input cosine (2) multiplied by the value of the amplitude response  $S(f)$  evaluated at  $f = 0.05$ .

*You have used 3 of 3 submissions*

### 5.2 QUIZ QUESTION 2 (1 point possible)

### 5.5 Lab 3 - Frequency Response

Lab due Nov 16, 2015 at 15:30 UTC 

► Topic 6: The Discrete Fourier Transform

► MATLAB download and tutorials

► MATLAB Sandbox

What is the numerical value of  $\phi$  for the problem above to two decimal places?

✖ Answer: 0.8020

#### EXPLANATION

The phase shift  $\phi$  is the sum of the phase of the input cosine (0) plus the phase response  $\theta(f)$  evaluated at  $f = 0.05$ .

*You have used 3 of 3 submissions*

### 5.2 QUIZ QUESTION 3 (1 point possible)

Suppose that the input to the linear time invariant channel has the form

$$x(n) = 2 \cos(0.1\pi n) + \cos(0.4\pi n)$$

for all  $n$  from  $-\infty$  to  $+\infty$ .

What is the value of the output at sample  $n=0$  to two decimal places?

✖ Answer: 1.2129

#### EXPLANATION

The output is given by

$$y(n) = 2 \cdot S(0.05) \cos(0.1\pi n + \phi(0.05)) + S(0.2) \cos(0.4\pi n + \phi(0.2))$$

At  $n = 0$ ,

$$y(0) = 2 \cdot S(0.05) \cos(\phi(0.05)) + S(0.2) \cos(\phi(0.2))$$

*You have used 3 of 3 submissions*

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