

EE150 Signal and System

Homework 5

Due on 23: 59, May 24, 2024.

Note:

- Please provide enough calculation process to get full marks.
- Please submit your homework to Blackboard in PDF version.
- It's highly recommended to write every exercise on a single sheet of page.
- Late submissions will have points deducted according to the penalty policy.
- Please use English only to complete the assignment, solutions in Chinese are not allowed.
- Plagiarizer will get zero points.
- The full score of this assignment is 100 points.

Exercise 1. (25pt)

Compute the Fourier transform of each of the following signals:

(a) $x[n] = (\frac{1}{3})^{|n|}u(-n-2)$

(b) $x[n] = 2^n \sin(\frac{\pi}{4}n)u[-n]$

(c) $x[n] = \sin(\frac{5\pi}{3}n) + \cos(\frac{7\pi}{3}n)$

Exercise 2. (25pt)

Find the inverse Fourier transform of the following functions.

(a) $X(e^{j\omega}) = e^{-j\omega/2}$

(b) $X(e^{j\omega}) = \frac{1}{e^{j2\omega} - \frac{1}{6}e^{j\omega} - \frac{1}{3}}$

(c) $X(e^{j\omega}) = \frac{2}{(1 - \frac{1}{2}e^{-j\omega})(1 - \frac{1}{4}e^{-i\omega})^2}$

Exercise 3. (25pt)

- (a) Consider a discrete-time LTI system with impulse response

$$h[n] = \left(\frac{1}{2}\right)^n u[n]$$

Use Fourier transforms to determine the response to the following input:

$$x[n] = (n+1)\left(\frac{1}{4}\right)^n u[n]$$

- (b) Suppose that

$$h[n] = \left(\frac{1}{2}\right)^n \cos\left(\frac{\pi n}{2}\right) u[n]$$

Use Fourier transforms to determine the response to the following input:

$$x[n] = \left(\frac{1}{2}\right)^n u[n]$$

Exercise 4. (25pt)

Let

$$y[n] = \left(\frac{\sin(\frac{\pi}{4}n)}{\pi n}\right)^2 * \left(\frac{\sin w_c n}{\pi n}\right)$$

where $*$ denotes convolution and $|w_c| \leq \pi$. Determine a strict constraint on w_c which

$$y[n] = \left(\frac{\sin(\frac{\pi}{4}n)}{\pi n}\right)^2$$