Digital Communication and Signal Processing 2024

Department of Computer Science, University of Warwick

Seminar 3

Summary of the Fourier Transform

1. Fourier Transform in terms of sin and cos: holds for periodic function only

$$x(t) = A_0 + \sum_{n=1}^{\infty} A_n \cos(\omega n t) + \sum_{n=1}^{\infty} B_n \sin(\omega n t)$$

2. Fourier Transform in terms of complex exponentials: holds for both periodic and non-periodic functions

$$X(F) = FT(x) = \int_{-\infty}^{\infty} x(t)\exp(-2\pi jFt)dt$$

$$x(t) = FT^{-1}(X) = \int_{-\infty}^{\infty} X(F)\exp(2\pi jFt)\, dF$$

Exercises:

Work out the Fourier Transform function of the given $f(x)$.

Question 1:

$$f(x) = \begin{cases} -k & if \quad -\pi < x < 0 \\ k & if \quad 0 < x < \pi \end{cases}$$

$$f(x + 2\pi) = f(x)$$

Question 2:

$$f(x) = \begin{cases} 0 & if \quad -2 < x < -1 \\ k & if \quad -1 < x < 1 \\ 0 & if \quad 1 < x < 2 \end{cases}$$

Where T=4.

Question 3:

$$f(x) = \begin{cases} 1 & if \quad |x| < 1 \\ 0 & if \quad |x| > 1 \end{cases}$$