Signals and Systems (NTUT-EE 320097)

4th Assignment

1. Suppose we are given the following information about a signal $x(t)$:

   1) $x(t)$ is real and odd.

   2) $x(t)$ is period with period $T = 2$ and has Fourier coefficients a_k.

   3) $a_k = 0$ if $|k| \geq 2$.

   4) $\frac{1}{2} \int_0^2 |x(t)|^2 \, dt = 1$.

   Please specify two different signals that satisfy these conditions.

2. $x(t) = t$ for $0 \leq t < 5$ is a periodic signal and the fundamental period $T = 5$. Please find the Fourier series of $x(t)$.

3. Assume that the relationship between the input signal $x(t)$ and output signal $y(t)$ of a linear time-invariant system is given by

$$y(t) = \int_{-\infty}^{t} e^{-2(t-\alpha)} x(\alpha - 1) d\alpha$$

   (a) Find the impulse response $h(t)$ of this system.

   (b) Is this system causal? Why?

   (b) Is this system stable? Why?

4. Consider the following three continuous-time signals with a fundamental period of $T = 1/2$:

$$x(t) = \cos(4\pi t)$$
$$y(t) = \sin(4\pi t)$$
$$z(t) = x(t)y(t).$$

   (a) Determine the Fourier series coefficients of $x(t)$.

   (b) Determine the Fourier series coefficients of $y(t)$.

   (c) Determine the Fourier series coefficients of $z(t)$.