Department of Electrical Engineering
School of Science and Engineering

EE310 Signals and Systems

TUTORIAL 6

Information:

- The following shorthand notation is often used to relate the signal $x(t)$ and its Fourier transform $X(j\omega)$:
$$\mathcal{F}\big\{x(t)\big\} = X(j\omega).$$
- We use the following properties of continuous-time Fourier transform:
$$\mathcal{F}\big\{x(t-t_{\text{o}})\big\} = e^{-jwt_{\text{o}}}\,X(j\omega).$$
$$\mathcal{F}\big\{e^{jw_{\text{o}}t}x(t)\big\} = X(j(\omega-\omega_{\text{o}})).$$
- For a real signal $x(t)$, its Fourier transform $X(j\omega)$ is conjugate symmetric, that is,
$$X(j\omega) = \Big(X(-j\omega)\Big)^*,$$
where $(\cdot)^*$ denotes the conjugate operation.

Tutorial 6-1

Determine the Fourier transform of the following signals

(a) $x(t) = e^{-\alpha t}u(t) \quad \alpha > 0$

(b) $x(t)$ in Figure 1. Also express the Fourier transform in terms of sinc function defined as

$$\text{sinc}(\theta) \triangleq \frac{\sin \pi\theta}{\pi\theta}.$$

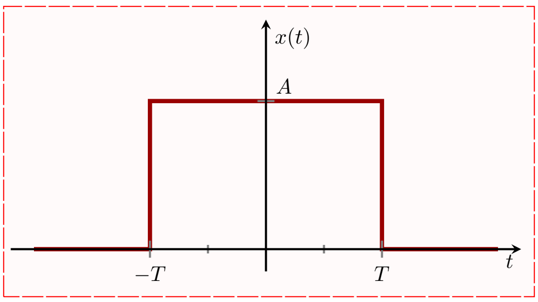

Figure 1: $x(t)$ for Problem 6-1(b).

Tutorial 6-2

Using the Fourier transform synthesis equation, determine the inverse Fourier transform:

(a) $X(j\omega) = \delta(w)$

(b) $X(j\omega) = 2\pi\delta(w) + \delta(w - 4\pi) + \delta(w + 4\pi)$

Tutorial 6-3

Using the result of previous problem, determine the Fourier transform $X(j\omega)$ of the continuous-time periodic signal $x(t)$ in terms of its Fourier series coefficients denoted by a_k.

Tutorial 6-4

Determine whether the Fourier transforms $X(j\omega)$ in Figure 1(a) and 1(b) correspond to real continuous time signal $x(t)$.

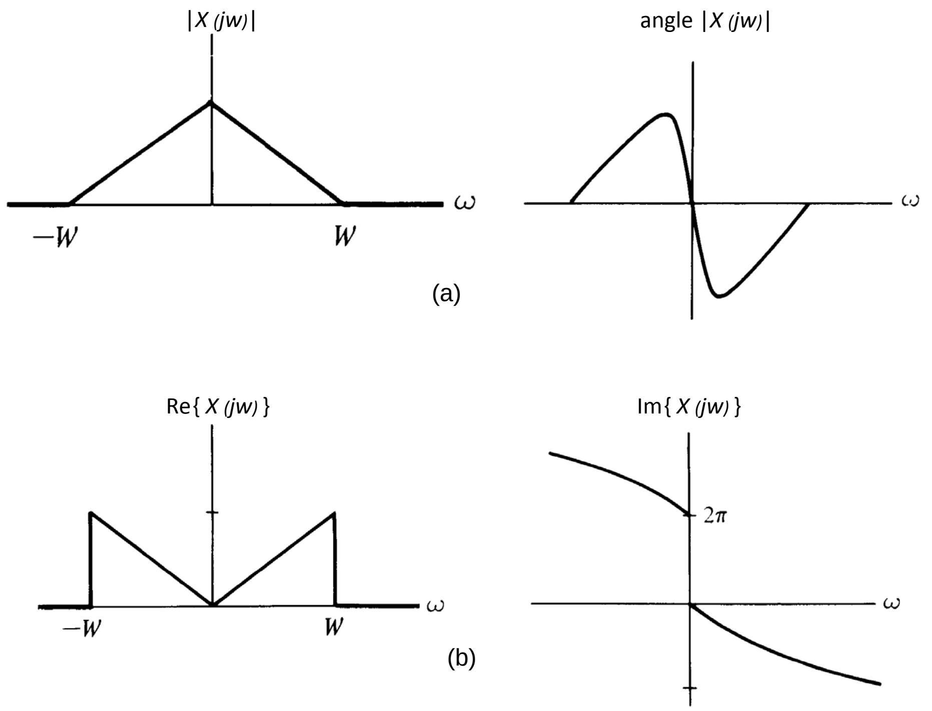

Figure 2: Problem 6-4