CG2023 ASSIGNMENT 3 (Fourier Transform)

1. The Fourier transform of signal $x(t) = e^{-\alpha t}u(t)$ is $X(f) = \frac{1}{\alpha + j2\pi f}$.

   (a) Find the Fourier transform $Y(f)$ of signal $y(t) = e^{\alpha t}u(-t)$ using the Fourier transform

   properties.

   (b) Find the Fourier transform $Z(f)$ of the signal $z(t) = e^{-|t|}$.

2. The waveform of signal $w(t)$ is shown in Figure 3.1.

   (a)   Find the expression of $w(t)$ in terms of rectangular pulses.

   (b)   Find the Fourier transform $W(f)$ of $w(t)$.

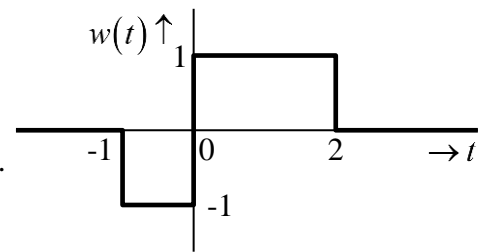   (c)   For the signal $y(t) = W(t)$, find $Y(f)$.

Figure 3.1

3. The signal spectrum $X(f)$ is shown in Figure 3.2.

   (a)   Find the time domain waveform $x(t)$ of $X(f)$.

   (b)   Sketch $Y(f)$ where $y(t) = x(t)\cos(2\pi t)$.

   (c)   Find the Fourier transform $Z(f)$ of the new signal

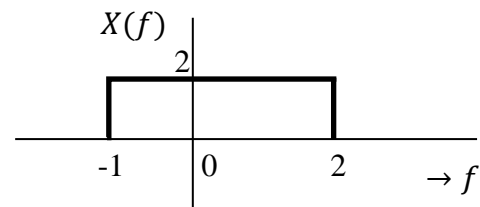 $z(t) = x(t)\cos(40\pi t) + jx(t)\cos(40\pi t)$.

Figure 3.2

4. Given the Fourier transform pair $\delta(t) \leftrightarrow 1$, find the Fourier transform of the signals using the Fourier

   transform properties.

   (a) The unit step function $u(t) = \int_{-\infty}^{t} \delta(\tau)d\tau$.

   (b) The signum function $\mathrm{sgn}(t) = 2u(t) - 1$.

   (c) The function $h(t) = \frac{1}{\pi t}$.

5. The signal $x(t)$ is shown in Figure 3.5. It is made of two half-cycles of two sinusoids.
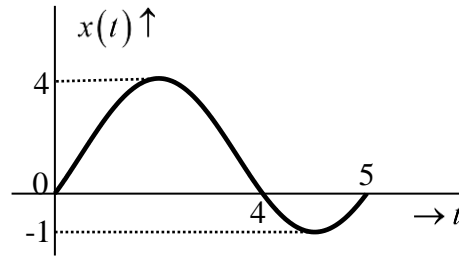

Figure 3.5

(a) Express $x(t)$ using sinusoids and rectangular functions.

(b) Find the Fourier transform $X(f)$ of $x(t)$.

(c) Let $z(t) = \sum_{n=-\infty}^{\infty} x(t - 10n)$. Find the Fourier series of $z(t)$.

6. Let $x(t) = \text{sinc}(t)$ and $y(t) = x(t) \times \sum_{n=-\infty}^{\infty} \delta(t - 2n)$. Find the Fourier transform $Y(f)$ of $y(t)$.