정보통신 수학 및 실습
Homework

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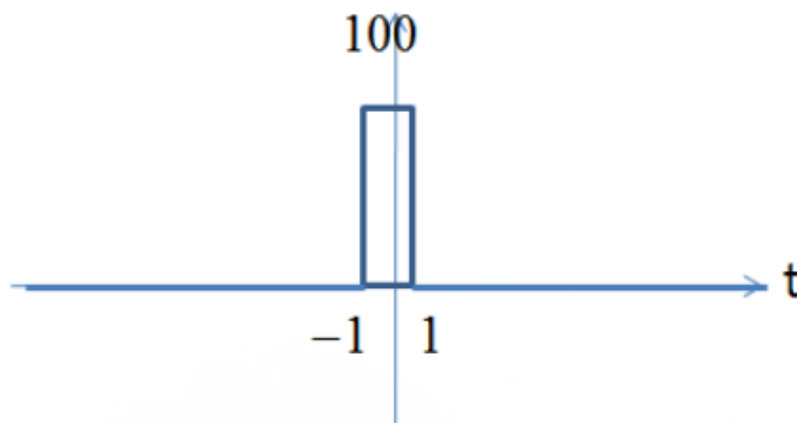
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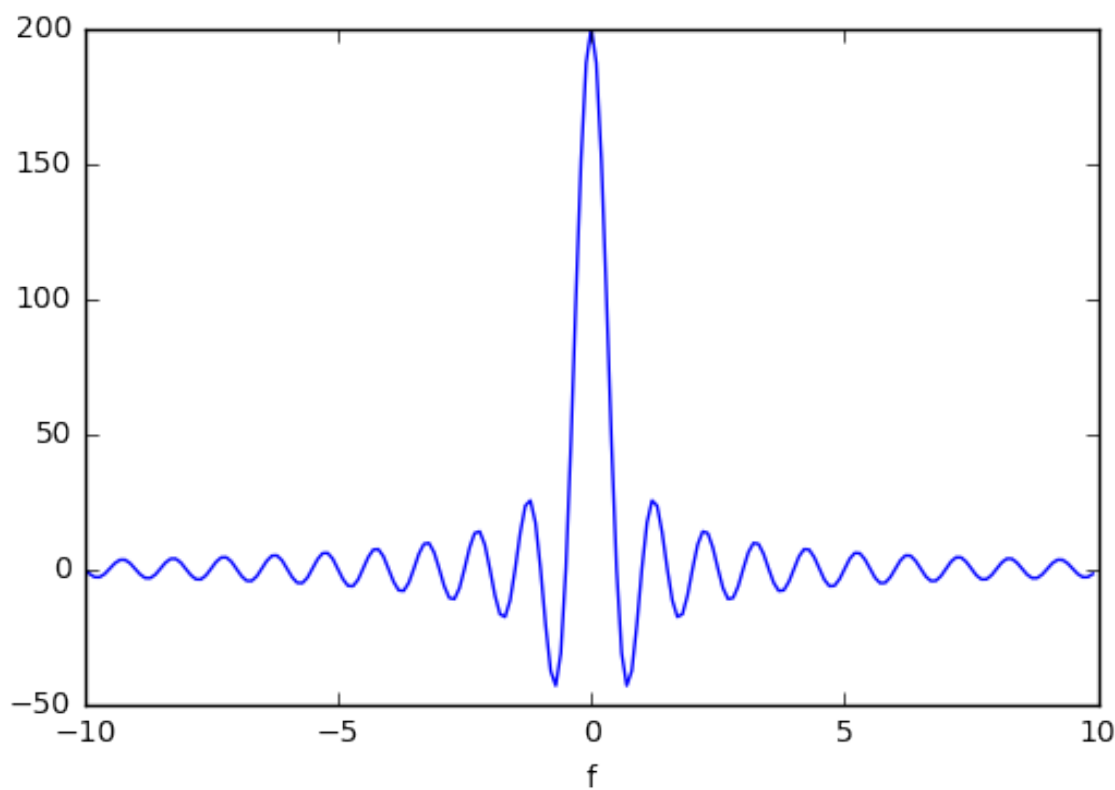dongguk
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Chapter 11 Homework

1. **Find the Fourier series of the following functions.**
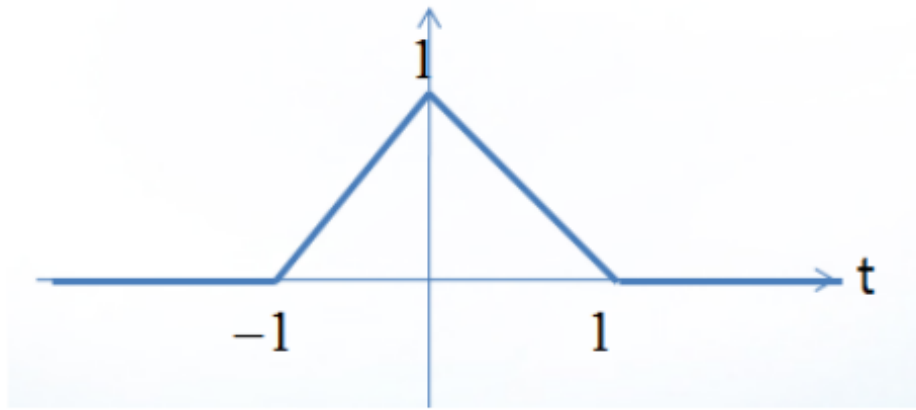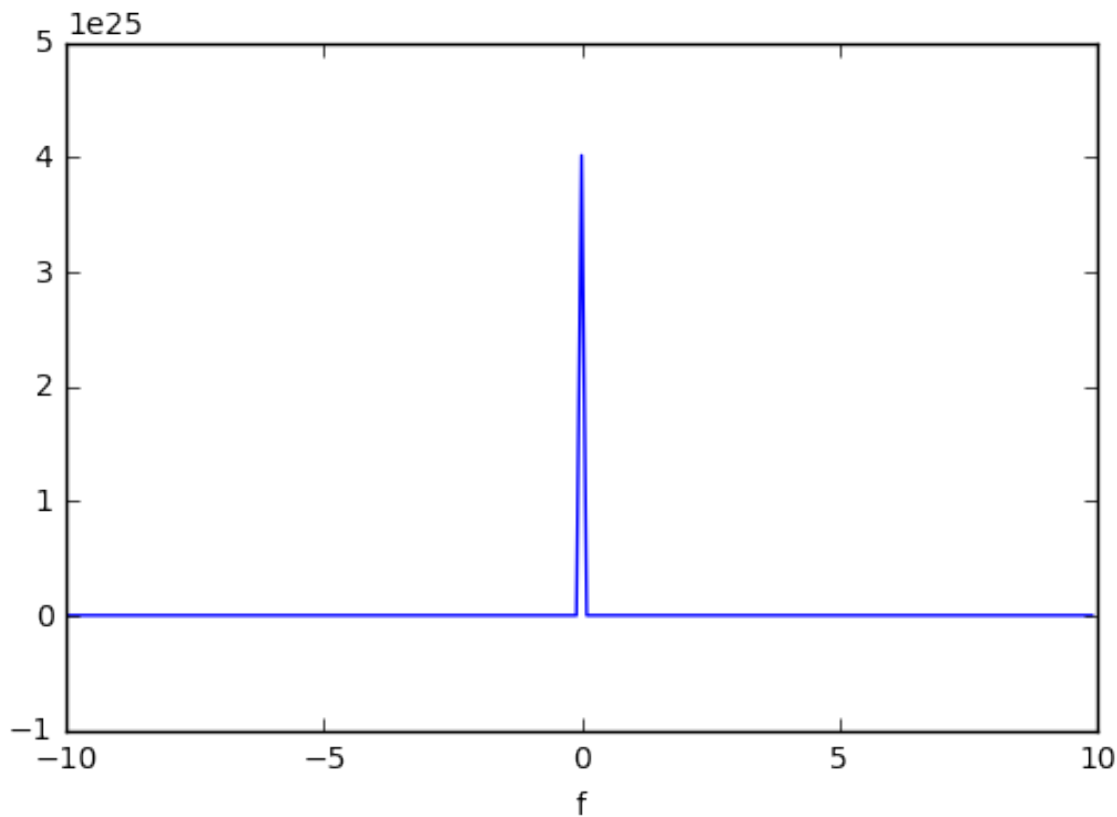
a.

$$\int_{-\infty}^{\infty} f(t)e^{-j2\pi ft}dt = 100\int_{-1}^{1} e^{-j2\pi ft}dt = 100\left[\frac{e^{-j2\pi ft}}{-j2\pi f}\right]_{-1}^{1} = 100\left(\frac{e^{-j2\pi f}}{-j2\pi f} - \frac{e^{j2\pi f}}{-j2\pi f}\right) = 100\left(\frac{e^{j2\pi f} - e^{-j2\pi f}}{j2\pi f}\right)$$

$$= 100\left(\frac{2j\sin 2\pi f}{j2\pi f}\right) = \frac{200\sin 2\pi f}{2\pi f}$$

b.

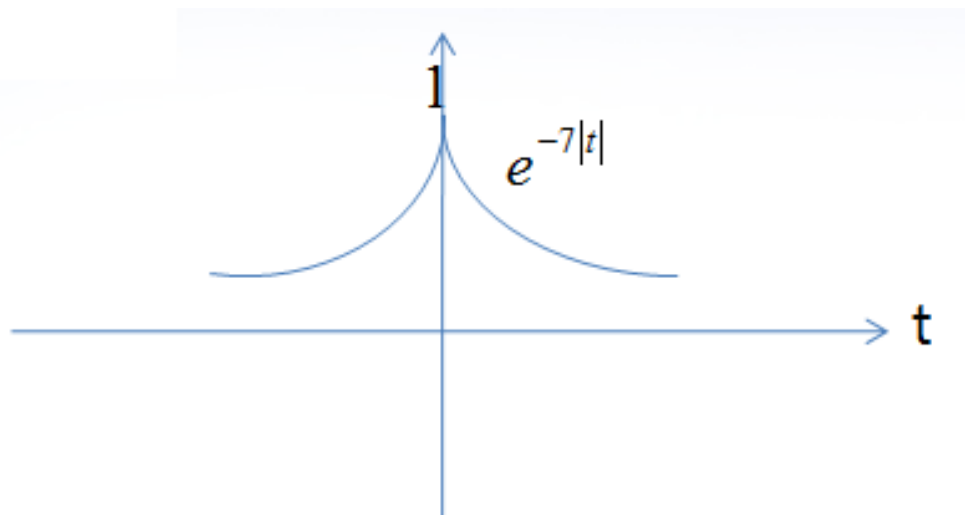$$\int_{-\infty}^{\infty} f(t)e^{-2j\pi ft}dt = \int_{-1}^{0}(x+1)e^{-2j\pi ft}dt + \int_{0}^{1}(-x+1)e^{-2j\pi ft}dt$$

$$= \int_{-1}^{0} xe^{-j2\pi ft}dt - \int_{0}^{1} xe^{-j2\pi ft}dt + \int_{-1}^{1} e^{-j2\pi ft}dt$$

$$\because \int uv' = uv - \int u'v$$

$$= \left[x\frac{e^{-j2\pi ft}}{-j2\pi f}\right]_{-1}^{0} - \int_{-1}^{0} \frac{e^{-j2\pi ft}}{-j2\pi f}dt - \left[x\frac{e^{-j2\pi ft}}{-j2\pi f}\right]_{0}^{1} + \int_{0}^{1} \frac{e^{-j2\pi ft}}{-j2\pi f}dt + \left[\frac{e^{-j2\pi ft}}{-j2\pi f}\right]_{-1}^{1}$$

$$= -\int_{-1}^{0} \frac{e^{-j2\pi ft}}{-j2\pi f}dt + \int_{0}^{1} \frac{e^{-j2\pi ft}}{-j2\pi f}dt = -\left[\frac{e^{-j2\pi ft}}{-4\pi^2 f^2}\right]_{-1}^{0} + \left[\frac{e^{-j2\pi ft}}{-4\pi^2 f^2}\right]_{0}^{1} = \frac{e^{-j2\pi f}}{4\pi^2 f^2} + \frac{e^{-j2\pi f}}{4\pi^2 f^2} = \frac{\cos(2\pi f)}{2\pi^2 f^2}$$

c.

$$\int_{-\infty}^{\infty} f(t)e^{-j2\pi ft}dt = \int_{-\infty}^{0} e^{7t}e^{-j2\pi ft}dt + \int_{0}^{\infty} e^{-7t}e^{-j2\pi ft}dt = \left[\frac{e^{(7-j2\pi f)t}}{7-j2\pi f}\right]_{-\infty}^{0} + \left[\frac{e^{(-7-2j\pi f)t}}{-7-j2\pi f}\right]_{0}^{\infty}$$

$$= -\frac{1}{7-j2\pi f} - \frac{1}{7+j2\pi f} = -\frac{14}{49+4\pi^2 f^2}$$