

### Question 1

Find the Hilbert transform of the bandpass signal with the spectrum shown in Fig. 1.

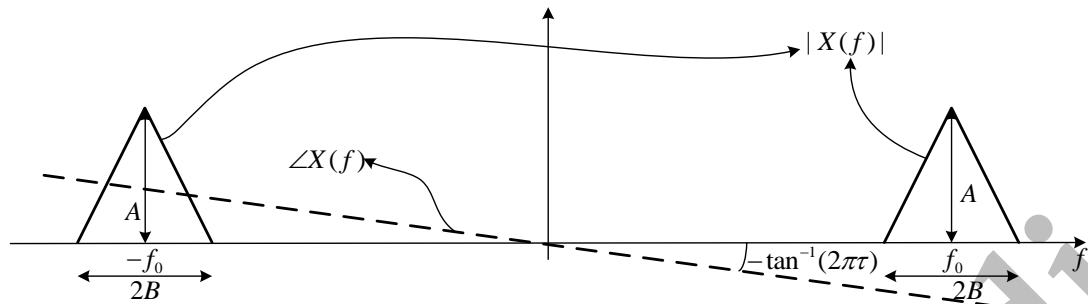


Figure 1: Spectrum of a bandpass signal.

$$X(f) = A\left[\Lambda\left(\frac{f - f_0}{B}\right) + \Lambda\left(\frac{f + f_0}{B}\right)\right]e^{-j2\pi\tau f}$$

$$X_a(f) = 2u(f)X(f) = 2A\Lambda\left(\frac{f - f_0}{B}\right)e^{-j2\pi\tau f}$$

$$x_a(t) = 2AB\text{sinc}^2(B(t - \tau))e^{j2\pi f_0(t - \tau)}$$

$$\hat{x}(t) = \Im\{x_a(t)\} = 2AB\text{sinc}^2(B(t - \tau))\sin(2\pi f_0(t - \tau))$$

### Question 2

Find the time-domain lowpass equivalent of the bandpass signal with the spectrum shown in Fig. 1.

$$x_l(t) = x_a(t)e^{-j2\pi t f_0} = 2AB\text{sinc}^2(B(t - \tau))e^{j2\pi f_0(t - \tau)}e^{-j2\pi t f_0} = 2AB\text{sinc}^2(B(t - \tau))e^{-j2\pi\tau f_0}$$