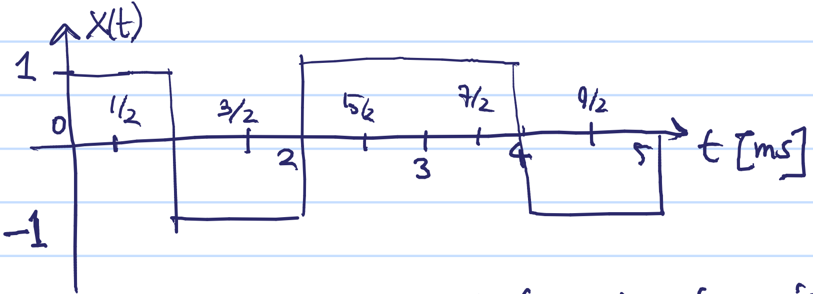
1. a



01001

b. $X(f) = \frac{1}{1000}\,\mathrm{sinc}\left(\frac{f}{1000}\right)\left(+e^{-j\pi f} - e^{-j3\pi f} + e^{-j5\pi f} + e^{-j7\pi f} - e^{-j9\pi f}\right)$

c. $X(1000) = 0 \Rightarrow \begin{cases} |X(1000)| = 0 \\ \arg X(1000) \text{ arbitrary} \end{cases}$

2. $x_c(t) = \sqrt{2}\,\mathrm{sinc}(t)\cos(2\pi 100 t + 2\pi t)$

a. $x_c(t) = \sqrt{2}\,\underbrace{\mathrm{sinc}(t)\cos(2\pi t)}_{x_I(t)}\cos(2\pi 100 t) - \sqrt{2}\,\underbrace{\mathrm{sinc}(t)\sin(2\pi t)}_{x_Q(t)}\sin(2\pi 100 t)$

b. $x_A(t) = \sqrt{x_I(t)^2 + x_Q(t)^2}$

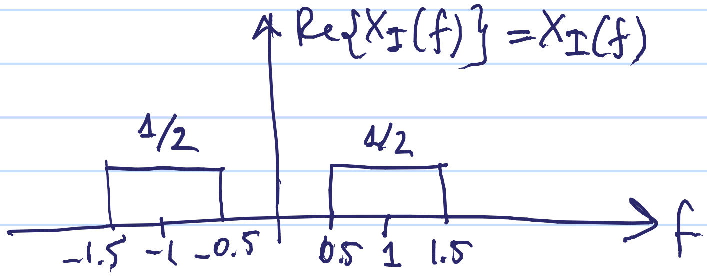
$= \sqrt{(\mathrm{sinc}(t))^2}$

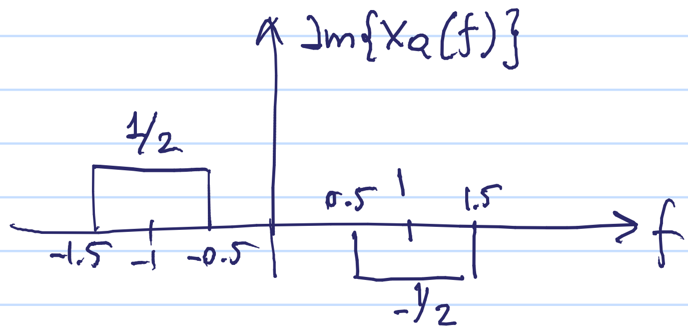
$= |\mathrm{sinc}(t)|$

c. $\mathrm{Re}\{X_z(f)\} = \mathrm{Re}\{X_I(f)\} - \mathrm{Im}\{X_Q(f)\}$

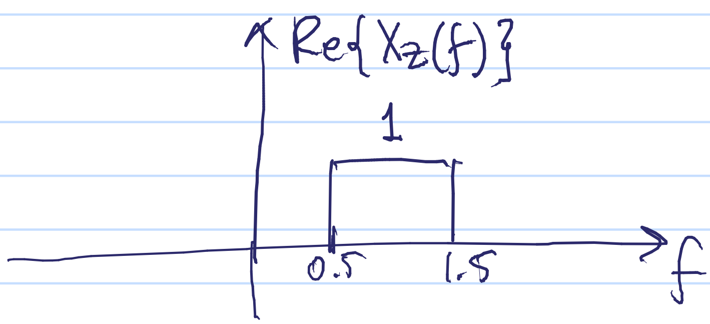
$X_z(f) = X_I(f) + j X_Q(f)$

where

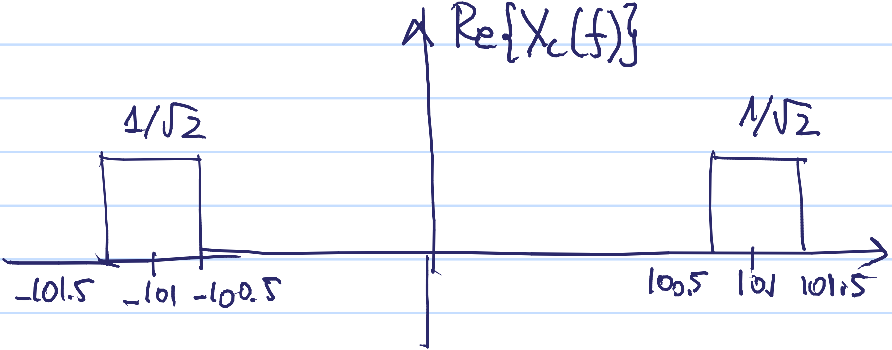




so:

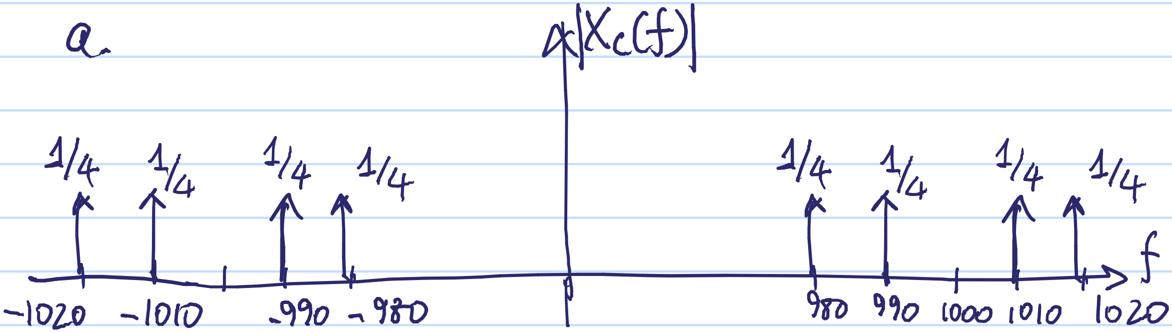


d. $X_c(f) = \frac{1}{\sqrt{2}}\left(X_z(f-f_c) + X_z^*(-f-f_c)\right)$

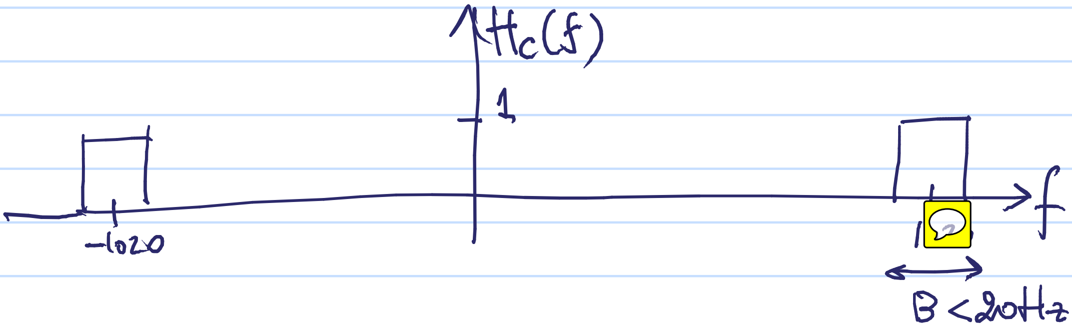


3. $x_c(t) = \left(\sin(20\pi t) + \cos(10\pi t)\right)\cos(2\pi\, 1000 t)$

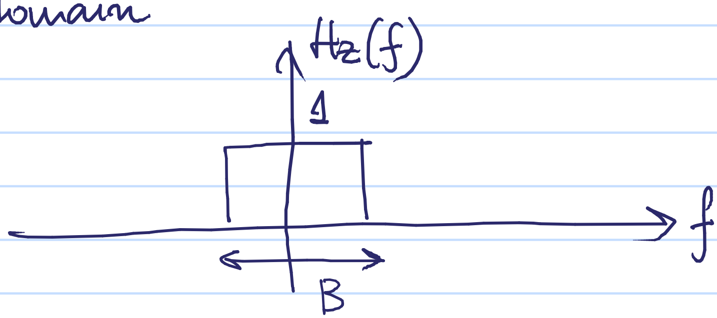
a.



We need a filter $H_c(f)$ as follows



b. Baseband domain



4. $B_T = 20\,MHz$

a. Since $B_T = 2W$ for AM, we have $W = 10\,MHz$

b. Since $B_T \simeq 2W(D+1)$ with $D = \frac{1}{2\pi}\frac{3\cancel{W}}{\cancel{W}} = \frac{3}{2\pi}$

we obtain

$$B_T \simeq 2W\left(1 + \frac{3}{2\pi}\right) = 20\,MHz$$

$$\Rightarrow W \simeq 6.7\,MHz$$