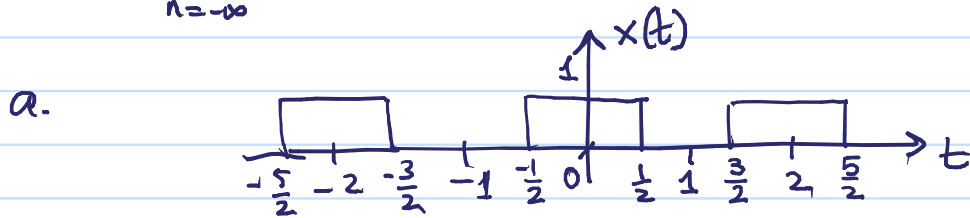


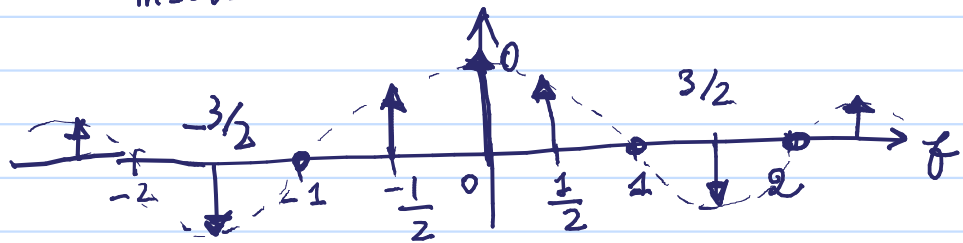
1.  $s(t)$  rectangle of unit height and spanning  $[-1/4, 1/4]$

$$x(t) = \sum_{n=-\infty}^{+\infty} s(t-2n)$$

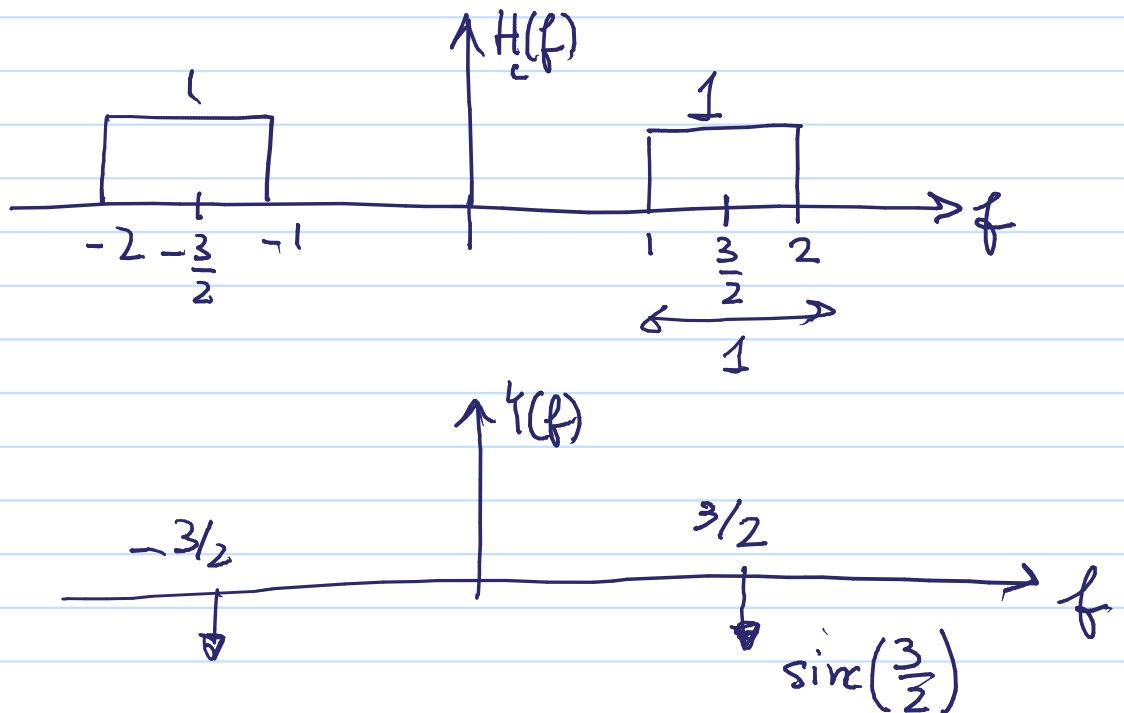


b. Calculate and plot  $X(f)$ .

$$X(f) = \sum_{m=-\infty}^{+\infty} \text{sinc}\left(\frac{1}{2}m\right) \delta\left(f - \frac{m}{2}\right)$$

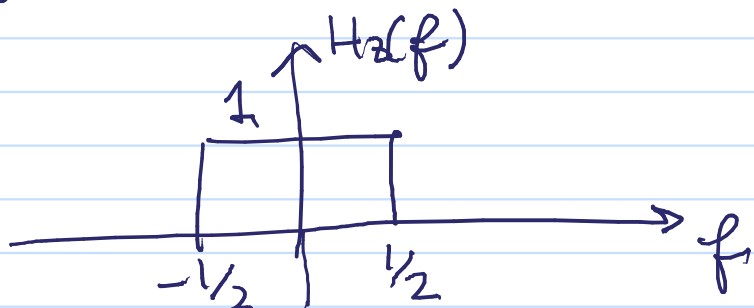


c. Bandpass filter  $f_c = 3/2$  and bandwidth 1 Hz



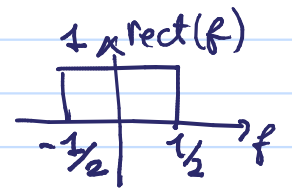
$$y(t) = 2 \sin\left(\frac{3}{2}t\right) \cos\left(2\pi \frac{3}{2}t\right)$$

d. Equivalent baseband filter



$$2. \ a. \ X_I(t) = \text{sinc}(t-1) \rightarrow X_I(f) = \text{rect}(f) e^{-j2\pi f}$$

$$X_Q(t) = 2 \text{sinc}(t) \rightarrow X_Q(f) = 2 \text{rect}(f)$$

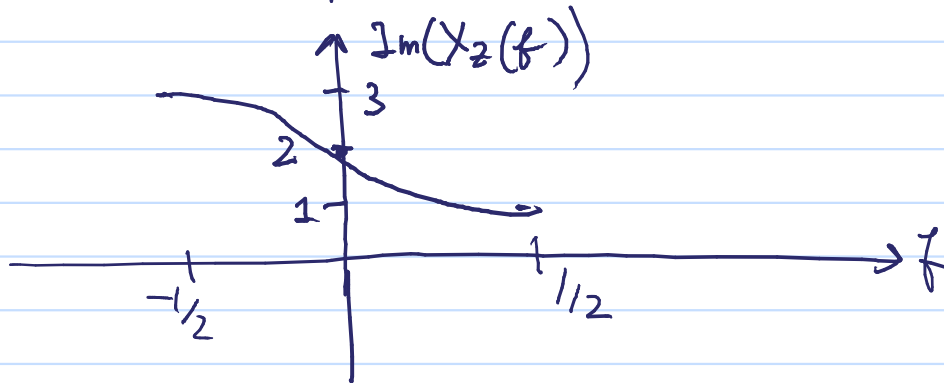
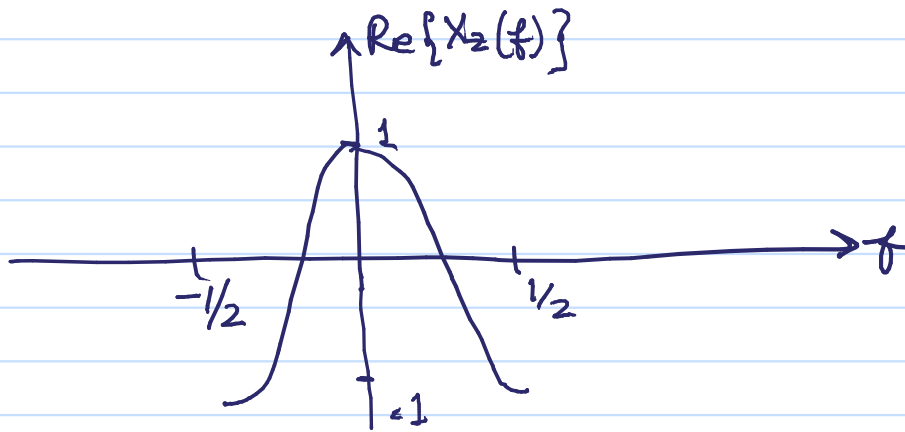


$$X_Z(f) = X_I(f) + j X_Q(f)$$

$$\begin{aligned} \text{Re}\{X_Z(f)\} &= \text{Re}\{X_I(f)\} - \text{Im}\{X_Q(f)\} \\ &= \text{rect}(f) \cos(2\pi f) \end{aligned}$$

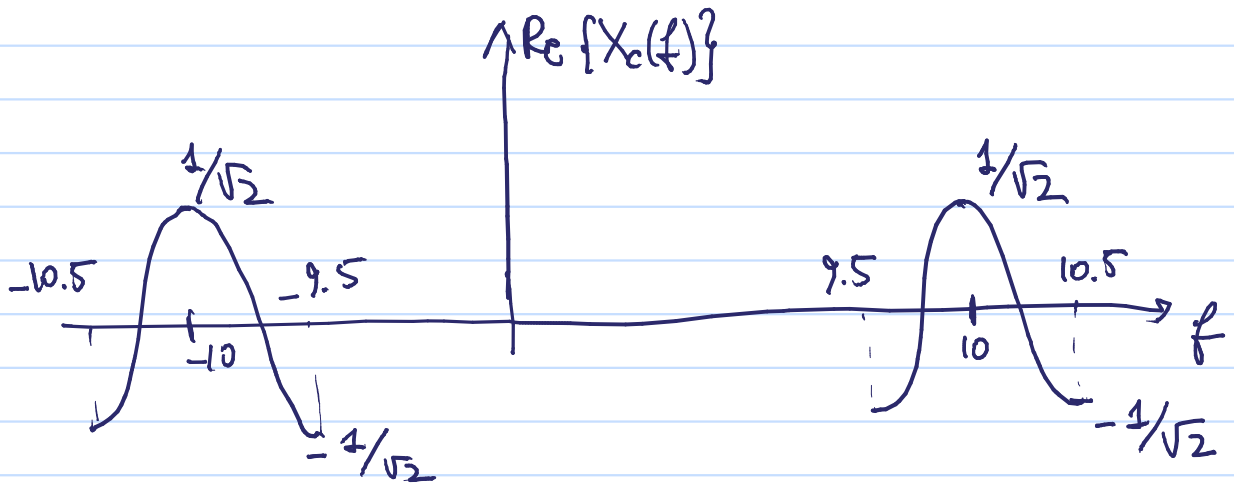
$$\begin{aligned} \text{Im}\{X_Z(f)\} &= \text{Im}\{X_I(f)\} + \text{Re}\{X_Q(f)\} \\ &= \text{rect}(f) (-\sin(2\pi f) + 2) \end{aligned}$$

b.

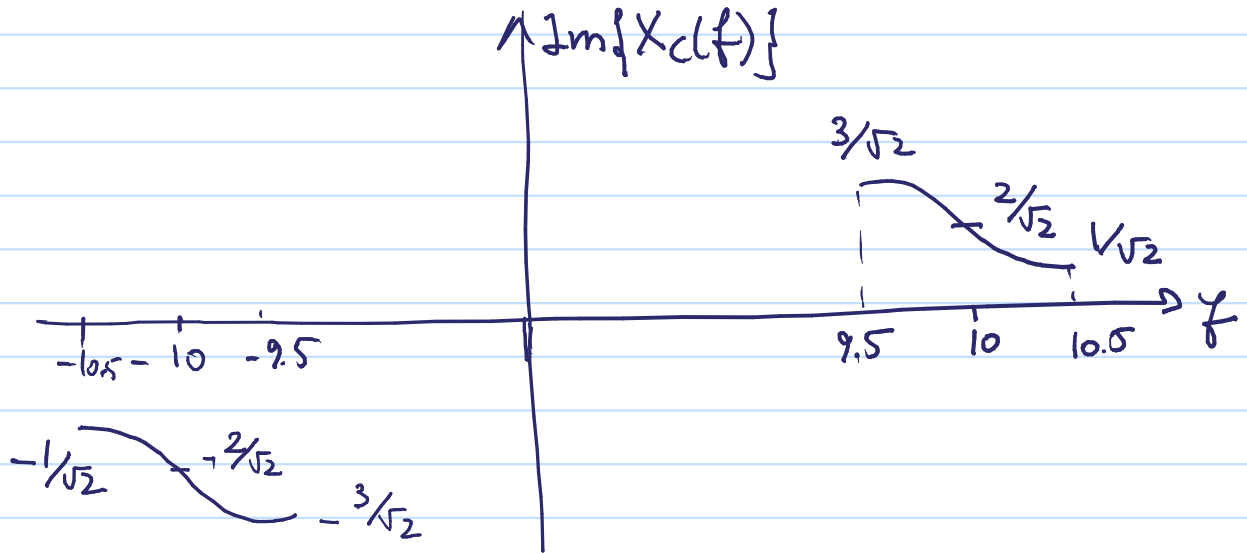


No Hermitian symmetry

c.



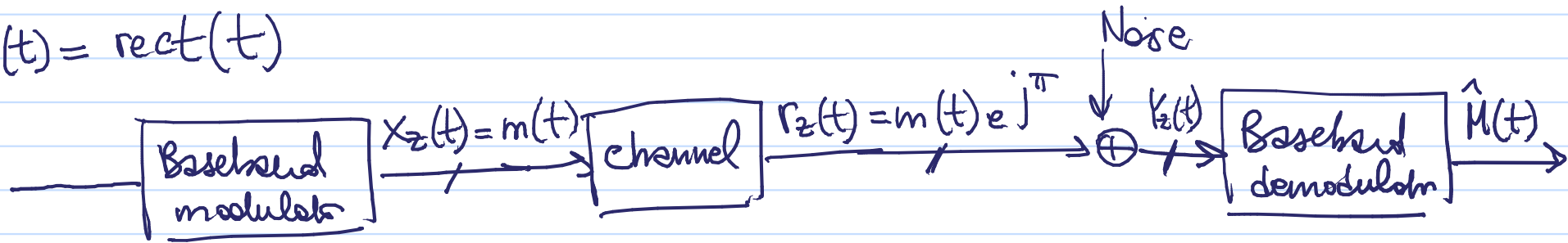
d.



$$e. \quad \frac{1}{T} = 10 \times 2 \times 10.5 = 210 \text{ Hz}$$

3.a.  $m(t) = \text{rect}(t)$

a.



b.  $\hat{M}(t) = \text{Re}\{y_z(t)e^{-j\pi t/2}\}$

$$\stackrel{\substack{\uparrow \\ \text{neglecting} \\ \text{noise}}}{=} \text{Re}\{m(t)e^{j\pi t/2}\} = m(t)\cos\frac{\pi}{2} = 0$$