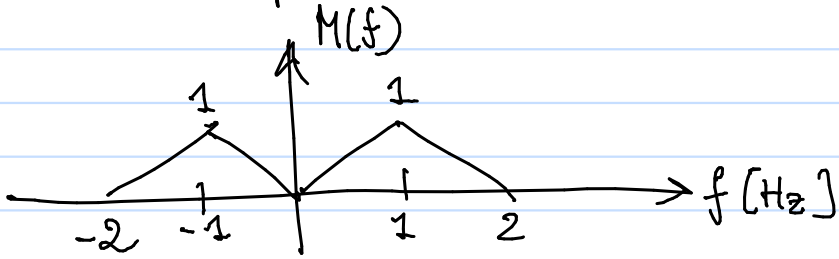
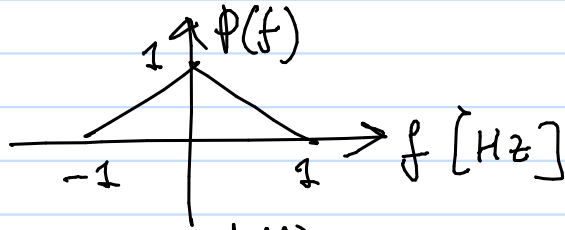
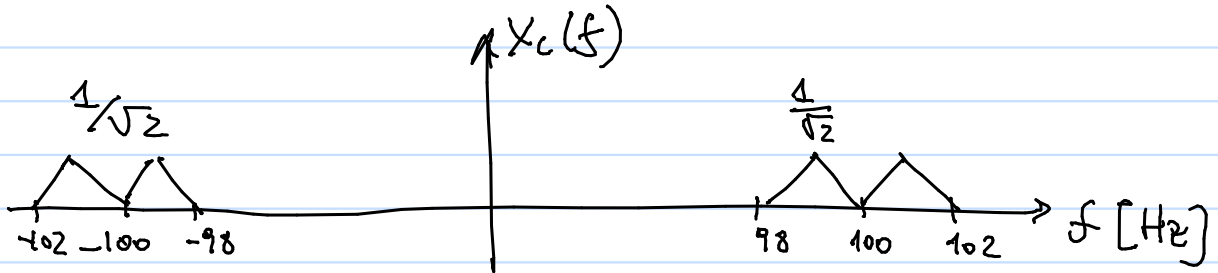


1. a.



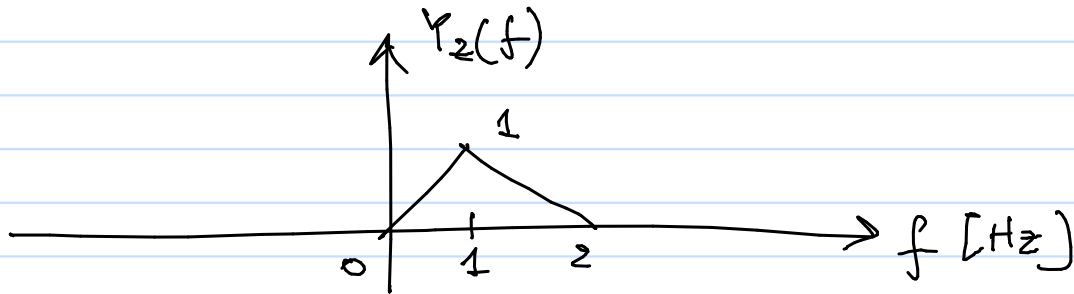
\Rightarrow



b.

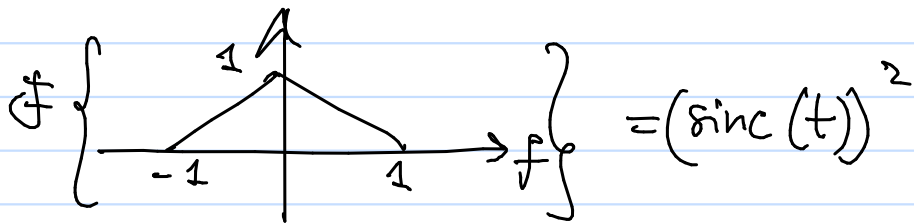


c.



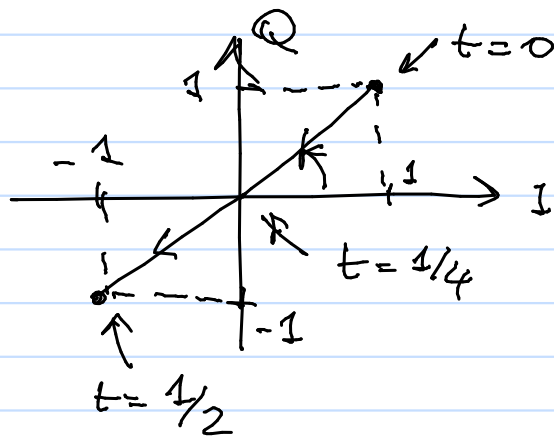
Complex due to lack of Hermitian symmetry.

d.

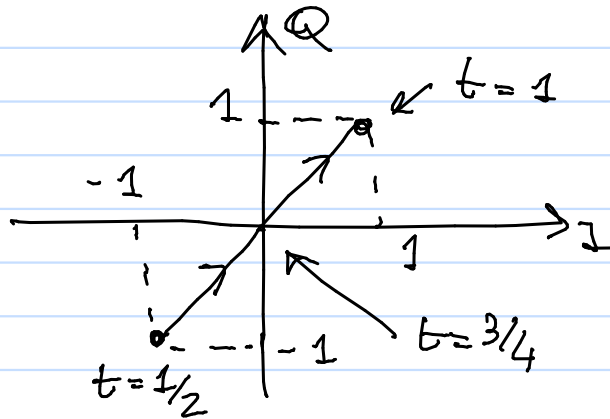


$$\Rightarrow y_2(t) = (\text{sinc}(t))^2 e^{j2\pi t}$$

2. a.

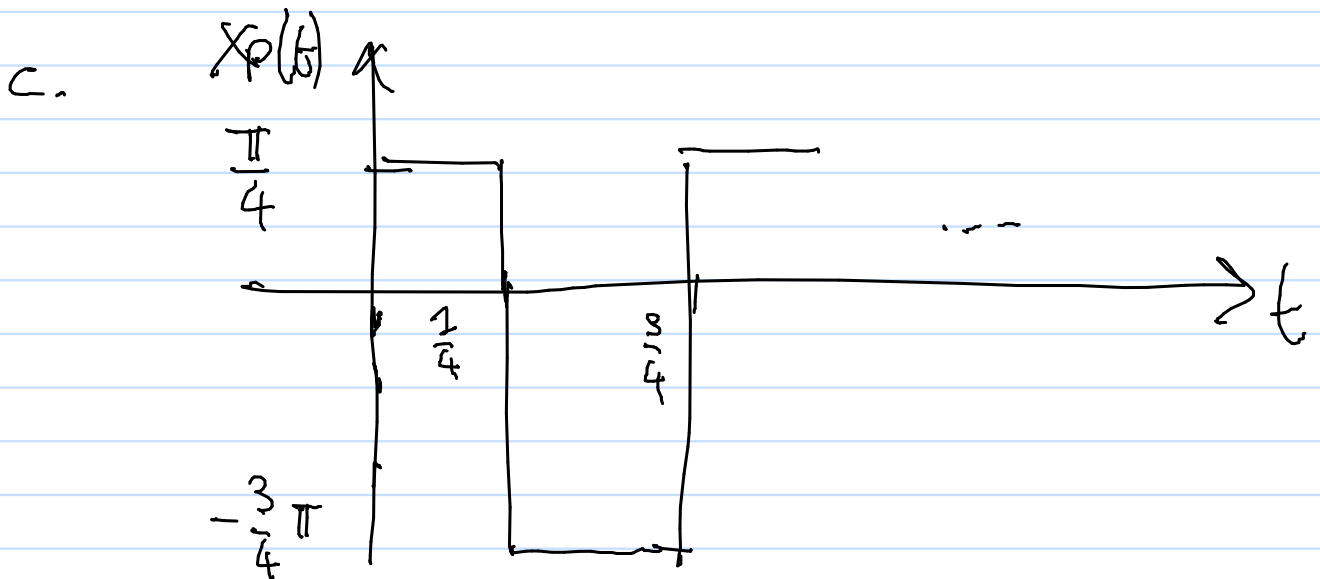
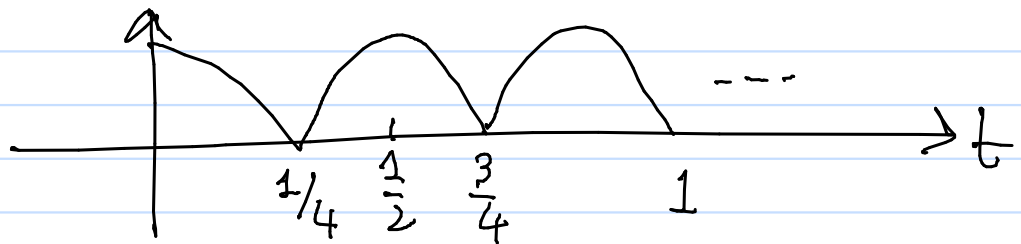


$$\text{for } 0 \leq t \leq \frac{1}{2}$$



$$\text{for } \frac{1}{2} \leq t \leq 1$$

b.
$$X_A(t) = \sqrt{X_I(t)^2 + X_Q(t)^2} = |\cos(t)|$$



$$d. X_c(t) = \left(\sqrt{2} \cos(2\pi t) \cos(2\pi f_c t) - \sqrt{2} \cos(2\pi t) \sin(2\pi f_c t) \right)$$

$$X_c(t) \times \cos(2\pi f_c t - \pi/4)$$

$$= \sqrt{2} \cos(2\pi t) \left(\frac{1}{2} \cos\left(\frac{\pi}{4}\right) \right) - \sqrt{2} \cos(2\pi t) \left(\frac{1}{2} \sin\left(\frac{\pi}{4}\right) \right)$$

+ higher frequency terms

= 0 after low-pass filtering

$$3. \quad m(t) = 3 \operatorname{sinc}(4t) \Rightarrow W = 2 \text{ Hz}$$

$$\text{FM: } B_T \approx 2W(1+D) = 4(1+D)$$

$$D = \frac{1}{4\pi} \max_t |m(t)| = \frac{3}{4\pi}$$

$$\Rightarrow B_T \approx 4\left(1 + \frac{3}{4\pi}\right)$$

$$E_B = \frac{W}{B_T} = \frac{1}{2\left(1 + \frac{3}{4\pi}\right)}$$