

Question 1

a) i)  $s_{pm}(t) = 4 \cos[10^4 \pi t + 8 \times 10^{-2} \sin(4\pi t) - 3 \times 10^2 \cos(12\pi t)]$

ii)  $\Delta \theta_{max} = 0.11$

iii)  $\Delta f_{max} = 0.34$

iv)  $f_i(t) = 5 \times 10^3 + 0.16 \cos(4\pi t) + 0.18 \sin(12\pi t)$

v)  $B_T \approx 13.32 \text{ Hz}$

b) i)  $s_{FM}(t) = 4 \cos[10^4 \pi t - \frac{24}{\pi} \cos(4\pi t) + \frac{24}{\pi} - \frac{3}{\pi} \sin(12\pi t)]$

ii)  $\Delta \theta_{max} = \frac{54}{\pi} = 16.234$

iii)  $\Delta f_{max} = \frac{66}{\pi} = 21.008$

iv)  $f_i(t) = 5 \times 10^3 + 15.279 \sin(4\pi t) - 5.730 \cos(12\pi t)$

v)  $B_T = 54.017 \text{ Hz}$

Question 2 :

a)  $R(k)_{NRZ \text{ unipolaire}} = \begin{cases} A^2/2, & k=0 \\ A^2/4, & k \neq 0 \end{cases}$

$P_{NRZ \text{ unipolaire}}(f) = \frac{10^{-5} A^2}{4} \left[ \frac{\sin(10^{-5} \pi f)}{(10^{-5} \pi f)} \right]^2 [1 + 10^5 \delta(f)]$

b)  $R(k)_{NRZ \text{ bipolaire}} = \begin{cases} A^2, & k=0 \\ 0, & k \neq 0 \end{cases}$

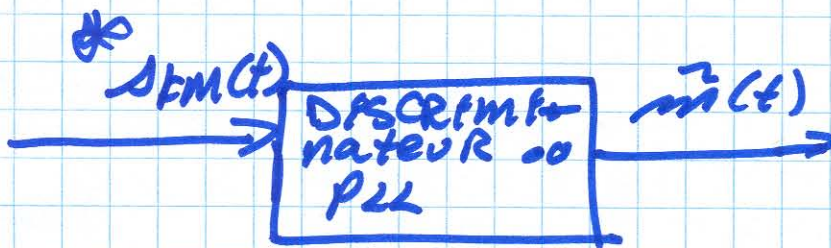
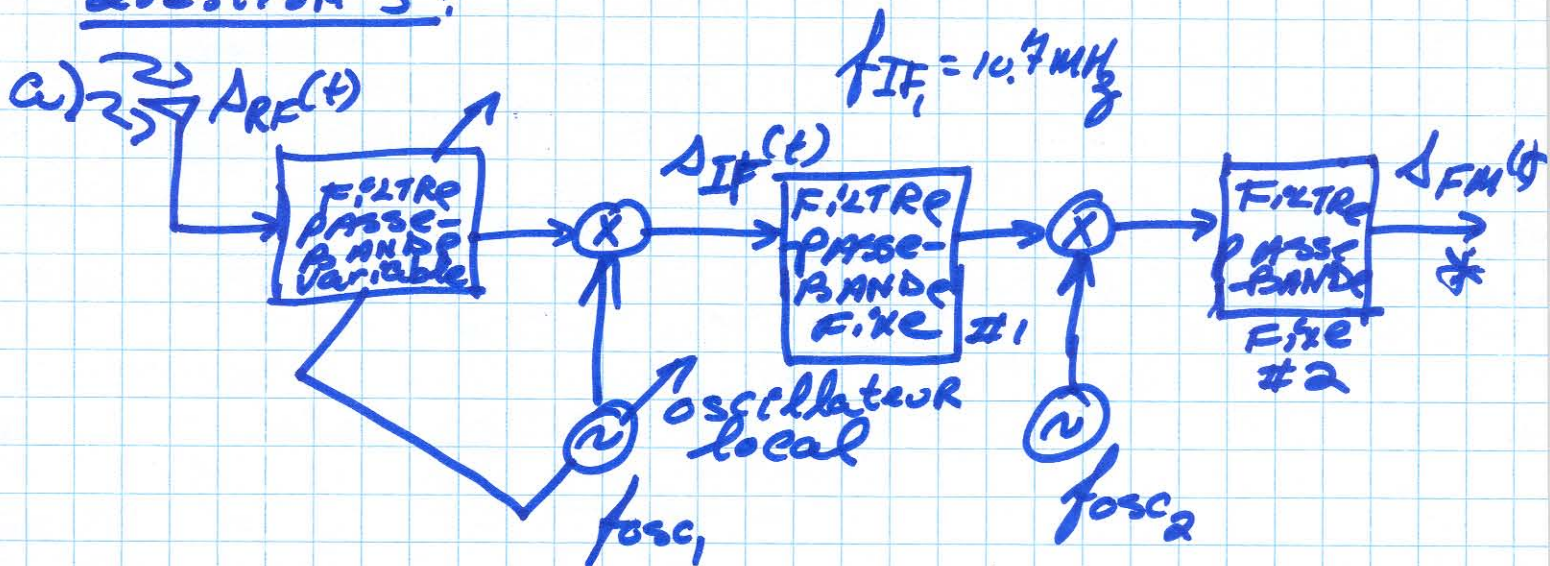
$P_{NRZ \text{ bipolaire}}(f) = 10^{-5} A^2 \left[ \frac{\sin(10^{-5} \pi f)}{(10^{-5} \pi f)} \right]^2$



c)  $R_{RZ \text{ unipolaire}}(k) = \begin{cases} A^2 & k=0 \\ A^2/4 & k \neq 0 \end{cases}$

$P_{RZ \text{ unipolaire}}(f) = (0.16)A^2 10^5 \left[ \frac{\sin(0.8 \times 10^{-5} \pi f)}{(0.8 \times 10^{-5} \pi f)} \right]^2 \times \left[ 1 + 10^5 \sum_{n=-\infty}^{\infty} \delta(f - n10^5) \right]$

### Question 3:



$132.7 \text{ MHz} \leq f_{osc1} \leq 180.7 \text{ MHz}$

$f_{osc2} = 11.155 \text{ MHz}$

⇒ Donnez une DESCRIPTION de chaque COMPOSANTE et SA FONCTION



(3)

$$b) B_T = 240 \text{ kHz}$$

$$c) N = 200 \text{ canaux}$$

Question 4:

$$a) f_s \geq 60 \text{ ksch./s}$$

$$b) m \geq 21.432 \Rightarrow m = 22$$

$$L = 2^m = 4194304 \text{ Niveaux}$$

$$c) R_b = 1.32 \text{ Mbits/s}$$

$$d) R_s (64 \text{ QAM}) = 220000 \text{ Symboles/s}$$

