Prelab 6

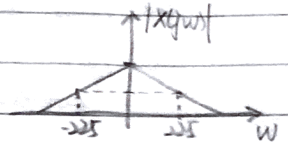
4. a). $x_{dash}(t) = 50te^{-15t}u(t)$

$$X_{dash}(jw) = \frac{50}{(15+jw)^2} = \frac{50}{225-w^2+30jw}$$

$$|X_{dash}(jw)| = \frac{50}{\sqrt{(225-w^2)^2+(30w)^2}} = \frac{50}{|225+w^2|}$$

$\therefore |X_{dash}(jw)|_{max} = \frac{50}{225} = \frac{2}{9}$

when $|X_{dash}(jw_c)| = \frac{2}{9\sqrt{2}}$, $\frac{50}{|225+w_c^2|} = \frac{2}{9\sqrt{2}}$, $w_c = 225$



$\therefore$ bandwidth is 225 for $x_{dash}(t)$.

$\because X_{dot}(t) = -x_{dash}(t)$

$\therefore |X_{dot}(jw)| = |X_{dash}(jw)|$

$\therefore$ bandwidth is also 225 for $x_{dot}(t)$.

$\because 225 > 200$

$\therefore$ This bandwidth doesn't work with this carrier frequency, we can decrease the exponent. (eg. decrease to e^{-14t})

b). xm = np.concatenate([dash, dot, dot, dash])

c). df1 = np.zeros(len(t))

df2 = np.zeros(len(t))

for i in range(len(t)):

    df1[i] = np.square(x[i] - dash[i])

    df2[i] = np.square(x[i] - dot[i])

error_dash = np.sum(df1)

error_dot = np.sum(df2)

** (here x is the signal to be compared)

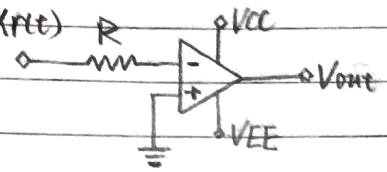
Q5. a). $y(t) = m_1(t)\cos(100t) + m_2(t)\cos(200t) + m_3(t)\cos(400t)$

to recover $m_1(t)$, $c(t) = \cos(100t)$, $\omega = 100$, $f_1 = \frac{\omega}{2\pi} = \frac{50}{\pi}$ Hz

to recover $m_2(t)$, $c(t) = \cos(200t)$, $\omega = 200$, $f_2 = \frac{\omega}{2\pi} = \frac{100}{\pi}$ Hz

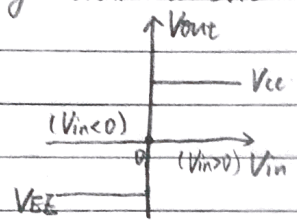
to recover $m_3(t)$, $c(t) = \cos(400t)$, $\omega = 400$, $f_3 = \frac{\omega}{2\pi} = \frac{200}{\pi}$ Hz

b). Feed output $x_r(t)$ to an amplifier:



$V_{cc} = 15V$, $V_{EE} = -15V$

Transfer characteristic:



∴ By examing whether $V_{out} = 0$ or $V_{out} = \pm V_{cc}$, we can determine the zero-slot, $V_{out} = 0$, which thus allow us to identify the ending of message signal