Problem 1

v(t) denotes a baseband signal to be amplitude modulated:

$$v(t) = 0.5 \cdot \cos(200 \cdot \pi \cdot t) + 1.0 \cdot \cos(400 \cdot \pi \cdot t)$$

a. The coefficients for an ordinary AM-modulation are:
   1. amplitude sensitivity: 0,5
   2. carrier frequency: 2 kHz
   3. carrier amplitude: 10

   Calculate the AM-signal $v_{AM}(t)$ and plot the spectrum $V_{AM}(f)$

b. Determine the result of a double-sideband–suppressed-carrier modulation (DSB-SC) of *v(t)* – with a carrier frequency and a carrier amplitude similar to "**a**".
   I.e. calculate the signal $v_{dsb\text{-}SC}(t)$ and plot the spectrum $V_{dsb\text{-}SC}(f)$

c. Compare the spectrum $V_{AM}(f)$ with the spectrum $V_{dsb\text{-}SC}(f)$

Problem 2

Consider the signals *x(t)* and *y(t)*:

$x(t) = A_x(\sin(2\cdot\pi\cdot 5.000\cdot t) + \mathrm{sinc}(2\cdot W_x\cdot t));$ Bandwidth W_x ~ 8 kHz
$y(t) = A_y(\sin(2\cdot\pi\cdot 14.000\cdot t) + \mathrm{sinc}(2\cdot W_y\cdot t));$ Bandwidth W_y ~ 12 kHz

Determine the Nyquist sampling rate for:

a. the signals *x(t)* and *y(t)*

b. the signals $x^2(t)$ and $y^2(t)$

c. the signal $x(t)\cdot y(t)$

Problem 3

A FM signal with modulation index β = 2 is transmitted through an ideal bandpass filter with center frequency f_c, (carrier amplitude 1 volt) and bandwidth $7\cdot f_m$, where f_c is the carrier frequency and f_m is the frequency of the sinusoidal modulating wave.
Determine the magnitude spectrum of the filter output.