1. Suppose we want to make a transmission mask that looks like a face. The face is a circle with diameter 200 mm and it has 100% transmission, except in the region of the eyes and mouth. The eyes have a transmission of 25% and a diameter of 40 mm. The eyes are centered horizontally, 37 mm on either side of the midline of the face, and are centered vertically, 32 mm above the center of the face. The mouth is an opaque rectangle that has a width of 125 mm and a height of 25 mm. The center of the mouth on the midline, but shifted 42 mm below the center of the face.
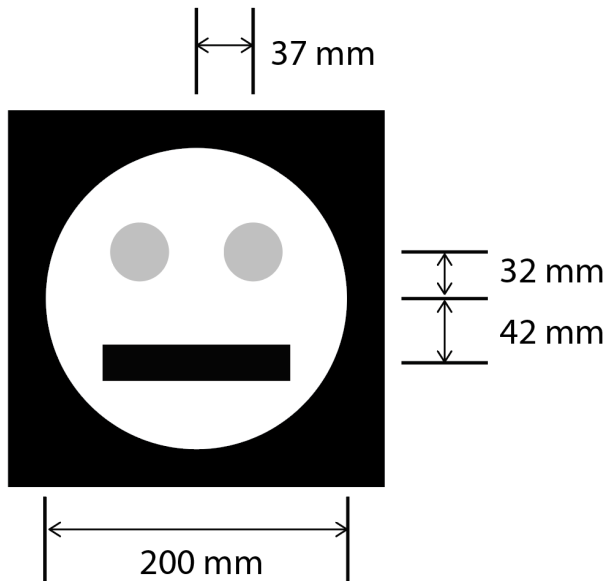
a) Create a description of the transmission of this filter $t(x, y)$?

b) Calculate the Fourier transform $T(\xi, \eta)$ of this filter.

2. An LSI system has an impulse response of $h(x) = Gaus(3x)$.

a) What is the transfer function $H(\xi)$ of the system?

b) For the input $f(x) = Gaus\left(\frac{x}{2}\right)$, what is the output $g(x)$ of the system?

c) Write your result from part (b) as a Gaus() function.

3. Compute the *complex* Fourier series for the function $f(x) = tri(x)$ defined over the range

   $-1 \le x < 1$, with period $X = 2$.

   a) Sketch a plot of $f(x)$ over its range.

   b) What is the fundamental frequency ξ_o of the series?

   c) Calculate the coefficients a_m of the series.

   d) Plot over the range $-6 \le x < 6$, the *real part* of the truncated Fourier series

   $$\sum_{m=-10}^{10} a_m exp(i2\pi m\xi_o x)$$

4. A transmission mask is described by

   $$t(x,y) = cyl(r)\left[rect(x)rect(y) - rect\left(2x - \frac{1}{2}\right)rect(y)\right]$$

   where $r = \sqrt{x^2 + y^2}$.

   a) Make a surface plot of this transmission function.

   b) What is the Fourier transform $T(\xi, \eta)$ of this mask? You can leave your final answer

   in the form of a convolution.