Homework 9 Gaussian Beams

1. Imagine 2-D x-z space. A beam of 780nm laser diode has a Gaussian shape of lateral profile. The intensity full-width at the level of 1/e^2 is equals 0.98 µm. A microscope objective with Mx=60 focuses this beam at 180 mm distance from the laser. Then obtained secondary image is focused to the distance 1 meter from laser using objective with Mx=4. Find the shape of the beam after passing through the optical system
   a. Analytical expression (matrices)
   b. Numerical substitution
   c. Plot in Mathematica

2. Imagine 2-D x-z space. A beam of He-Ne laser at the output cross-section has a Gaussian shape of lateral profile. The intensity full-width at the level of 1/e^2 is equals 600 µm. Find analytically the shape of the beam (q parameter) at the distance of 10 meters. Then a lens with focal distance 3 m is placed in the cross-section of the beam. A screen placed at 4 m after the lens.
   a. Analytical expression of the q parameter at the screen cross-section
   b. Numerical substitution
   c. Plot in Mathematica
   d. 3-D Plot of z-scan of the x-axis profile Mathematica (z ranging from 2 to 10 meters after the lens)