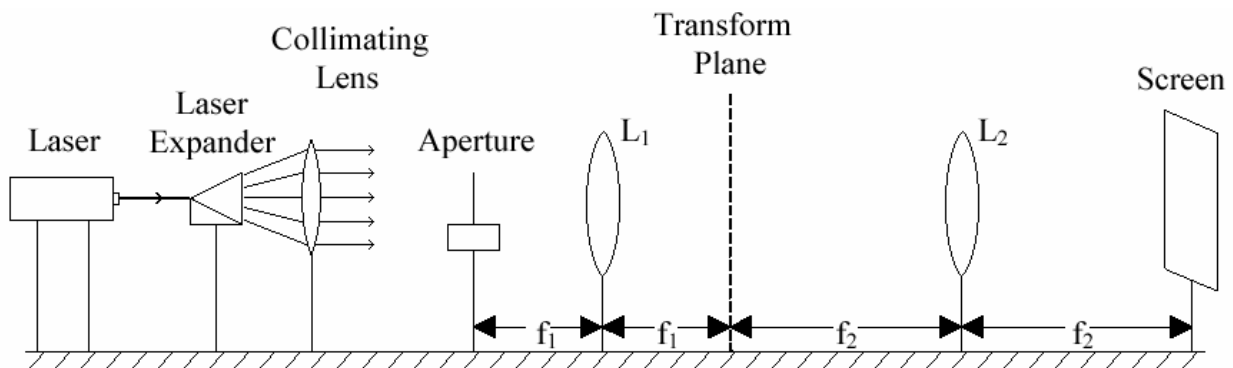


A converging lens can be used to create a Fourier transform of an aperture. The set-up shown below has two Fourier transform units in series. The transform of the aperture appears in the back focal plane of L_1 (transform plane), which represents a new object for L_2 . Hence the image which appears on the screen at L_2 's back focal plane is the transform of the transform. In this way, we return to an image nearly identical to the original aperture. Unfortunately, the image cannot be perfect. This arises from the fact that we only catch light diffracted at sufficiently small angles to enter our lens system. Since the higher spatial frequencies are diffracted at greater angles, this information is lost. As a result the image will not have perfectly sharp edges.

This lab has two parts. In part A, you will use various apertures, and examine their diffraction patterns and images. In part B, you will place masks in the transform plane to manipulate the appearance of the final image. You will be asked to take two photographs; the rest of the data will consist of your observations. As this will be qualitative, please take detailed notes in your lab book.



Procedure:

- A. Examine the diffraction pattern in the transform plane and the image on the screen for the following apertures: single slit, parallel line grid, and very fine parallel line grid. Make a sketch of the diffraction patterns and images to include in the write-up. For each case, explain/justify the appearance of the diffraction patterns and images.
- B. Place various masks in the transform plane to selectively remove certain Fourier components of the image. Starting with the following apertures, make masks which perform the specified function. In each case, make a sketch of the resulting image, and explain/justify its appearance.

Aperture

- (1) parallel line grid
- (2) cut out figure
- (3) parallel lines + “things”

Mask

- remove the central maximum
- remove the central maximum
- Remove all the diffraction spots, allow everything else through. The dots may be so close together that they appear as a line.

For the last item, the “things” may be dirt and smudge marks already on the grid. You can also put small bits of tape. For this item, please take a photograph of the original object and the optically filtered image for your write-up.