Meeting 7:

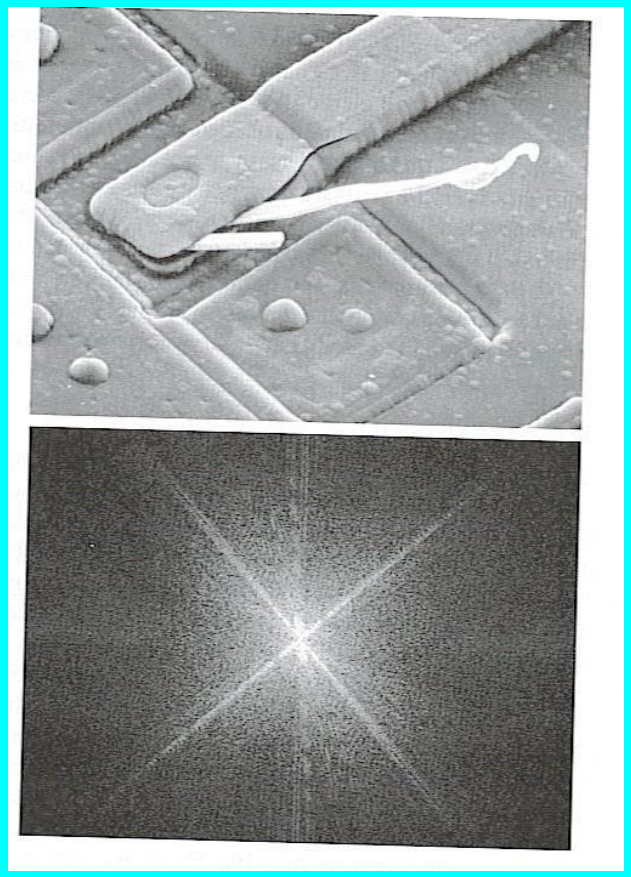
First part of the Meeting: Mid term exam.

Beak: Pizza time.

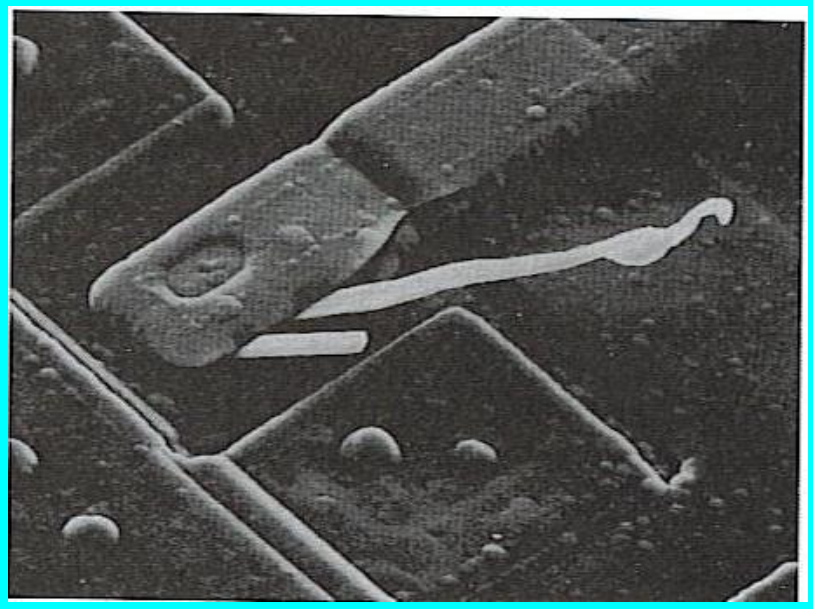
Second part of the Meeting: Lectures 14, 15:

- **Correspondence between Filtering in the Frequency and Spatial Domains.**
- **Ideal, Butterworth, and Gaussian Low-pass Filters.**
- **Ideal, Butterworth, and Gaussian High-pass Filters.**

Notch Filter



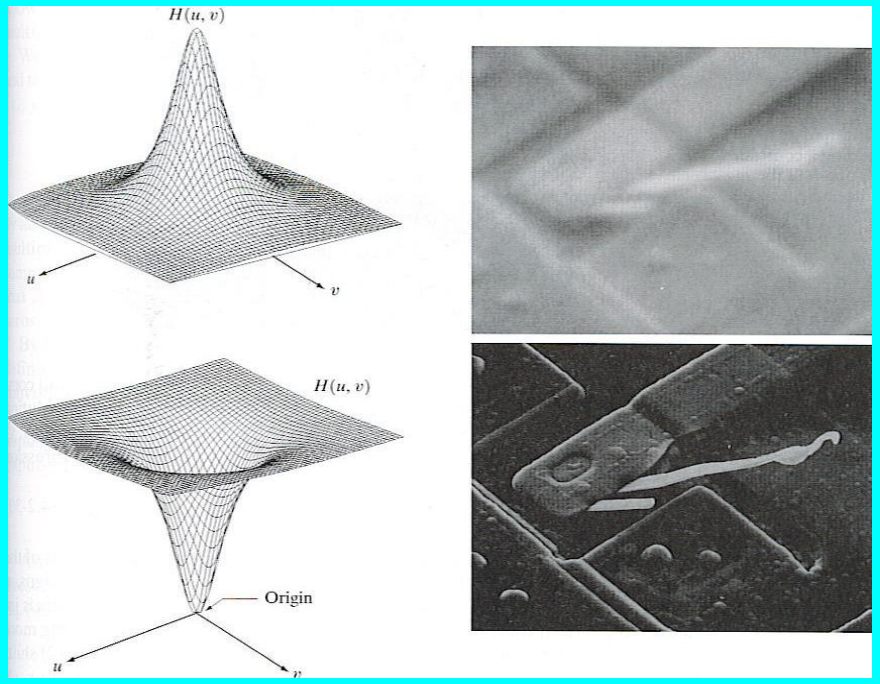
A



B

Figure 1. A) An image and its centered Fourier Spectrum
B) Result of filtering the image in A) with a filter that set F(0,0) to 0.
(Digital Image Processing, 2nd E, by Gonzalez, Richard, 2nd Ed, Prentice Hull, 2002).

Low, High Pass Filtering



a)

b)

Figure 2. a) 2D low-pass filter and result of low-pass filtering; b) 2D high-pass filter and result of high-pass filtering the image from Fig.1.A. (Digital Image Processing, 2nd E, by Gonzalez, Richard, 2nd Ed, Prentice Hull, 2002).

ideal low-pass filter

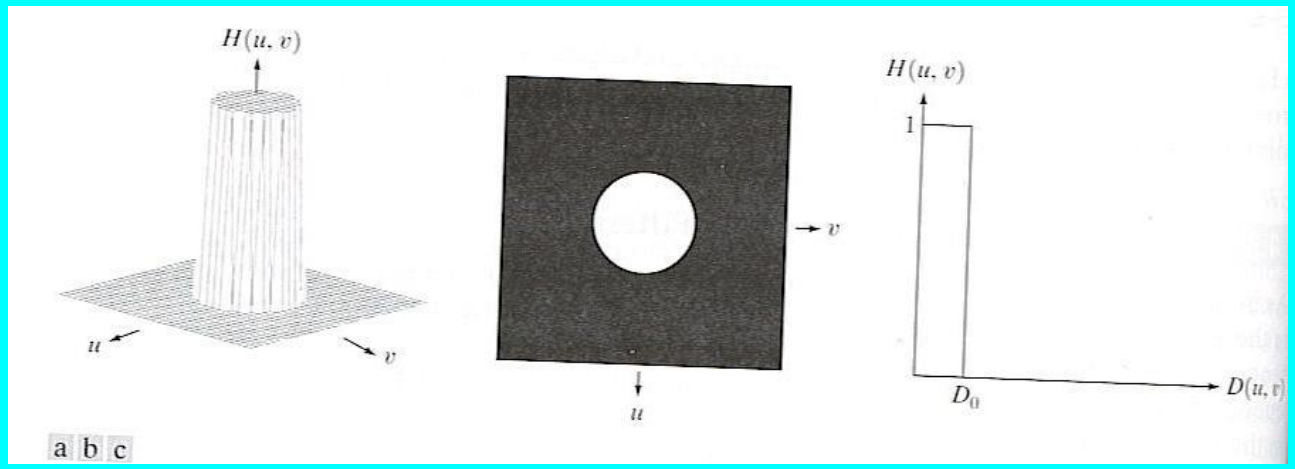
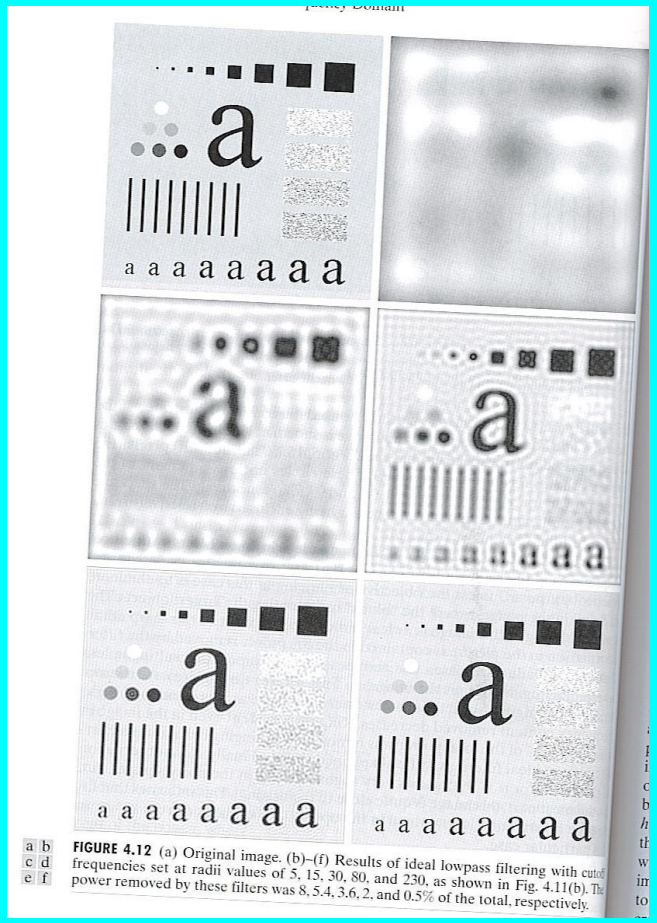


Figure 3. a) Plot of an ideal low-pass filter; b) Filter displayed as an image; c) radial cross section of the filter given in Fig.3.c.

(Digital Image Processing, 2nd E, by Gonzalez, Richard, 2nd Ed, Prentice Hull, 2002).

Butterworth low-pass filter

a)



b)

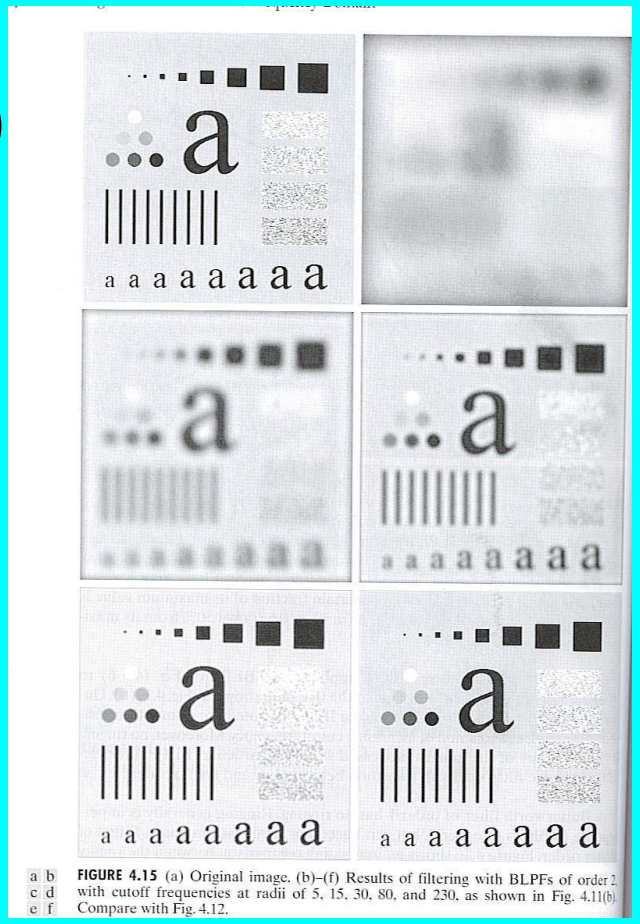
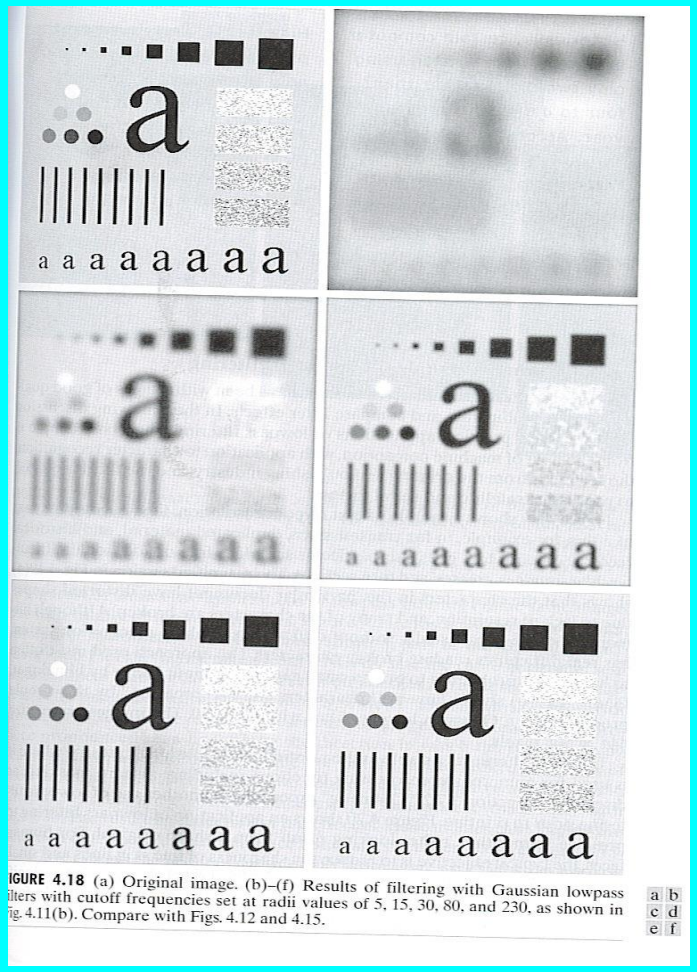


Figure 4. a) upper left is original the other are results produced by low-pass filtering with cutoff frequency set at radii 5,15,30,80,230.

b) The same as in a) but using Butterworth LPF.

(Digital Image Processing, 2nd E, by Gonzalez, Richard, 2nd Ed, Prentice Hull, 2002).

Gaussian low-pass filter



IGURE 4.18 (a) Original image. (b)–(f) Results of filtering with Gaussian lowpass ilters with cutoff frequencies set at radii values of 5, 15, 30, 80, and 230, as shown in ig. 4.11(b). Compare with Figs. 4.12 and 4.15.

Figure 5. upper left is original the other are results produced by low-pass filtering with cutoff frequency set at radii 5,15,30,80,230.

(Digital Image Processing, 2nd E, by Gonzalez, Richard, 2nd Ed, Prentice Hull, 2002).

high-pass filtering- Butterworth, Gaussian

a)

b)

c)

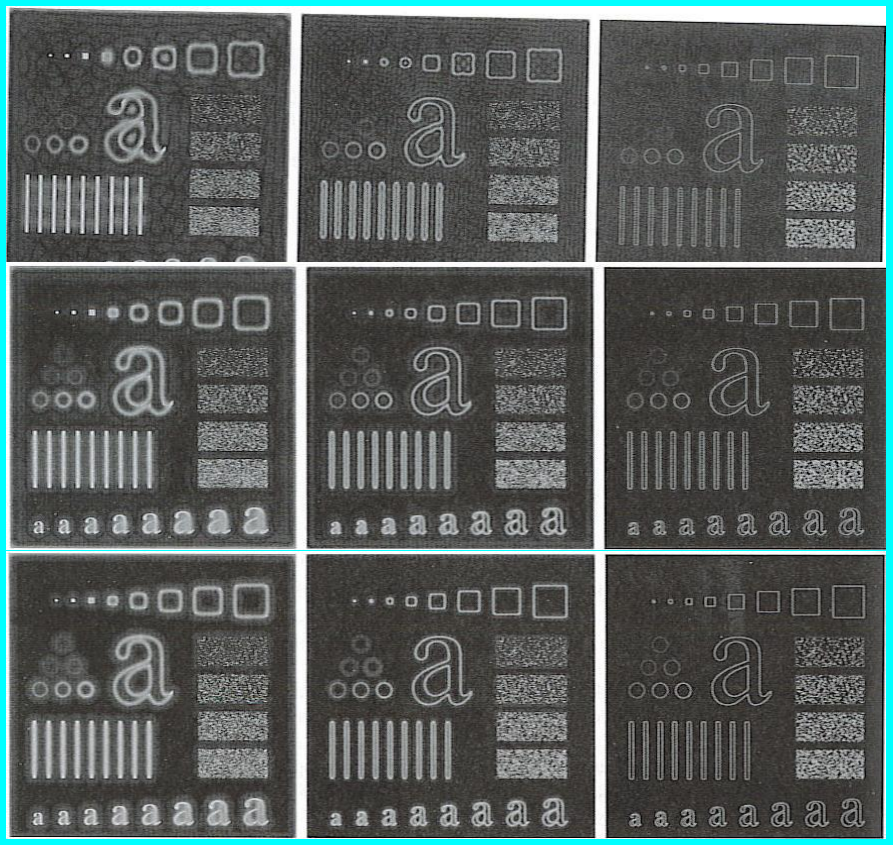


Figure 6. a) result of high-pass filtering of the upper left image in Fig.5. with D_0 =15, 30, 80 respectively. Ringing is quite evident.

b) high-pass filtering using BHPF. Much soother results than a).

c) high-pass filtering using GHPF. Best results.

(Digital Image Processing, 2nd E, by Gonzalez, Richard, 2nd Ed, Prentice Hull, 2002).