1 QUESTION

Filter Observations

1. Low Pass Filter (ILPF) (D0 = 10):

The low-pass filter results in a blurred output image. The filter passes only low-frequency components (smooth transitions), and the checkerboard pattern loses its sharpness. The larger the D_0, the less blurring, but with $D_0 = 10$, the image retains mainly large, smooth areas.

2. Band Pass Filter 1 (IBPF) (10-20):

This band-pass filter retains frequencies between 10 and 20. The result shows a mixture of smoothed and mid-level details. The frequency components between 10 and 20 are highlighted, adding some sharpness to the smoother regions.

3. Band Pass Filter 2 (IBPF) (20-30):

This band-pass filter retains slightly higher frequencies, producing sharper details in the image compared to the first band-pass filter. The high-contrast checkerboard squares start to emerge more clearly, but without very fine details.

4. High Pass Filter (IHPF) (D0 = 30):

The high-pass filter retains the high-frequency components, allowing sharp edges and fine details to pass through. The resulting image focuses on the outlines and high-contrast areas, making the checkerboard pattern very pronounced.

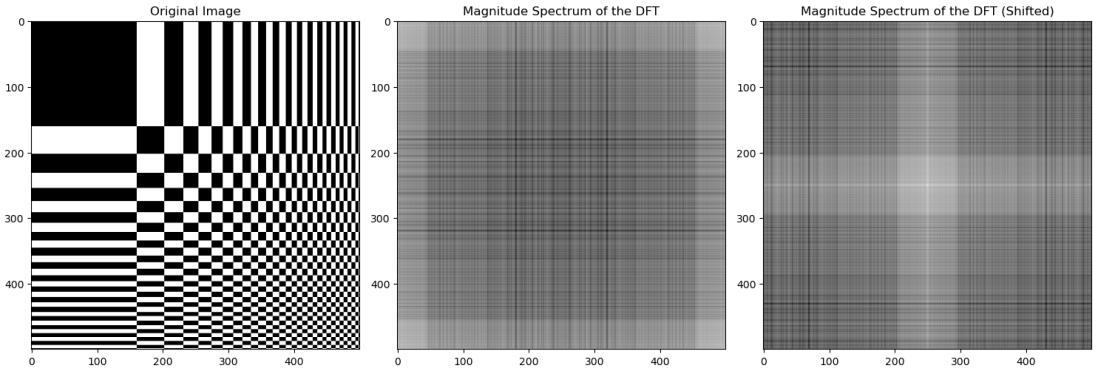

Figure 1: Magnitude Spectrum of the DFT and DFT Shifted

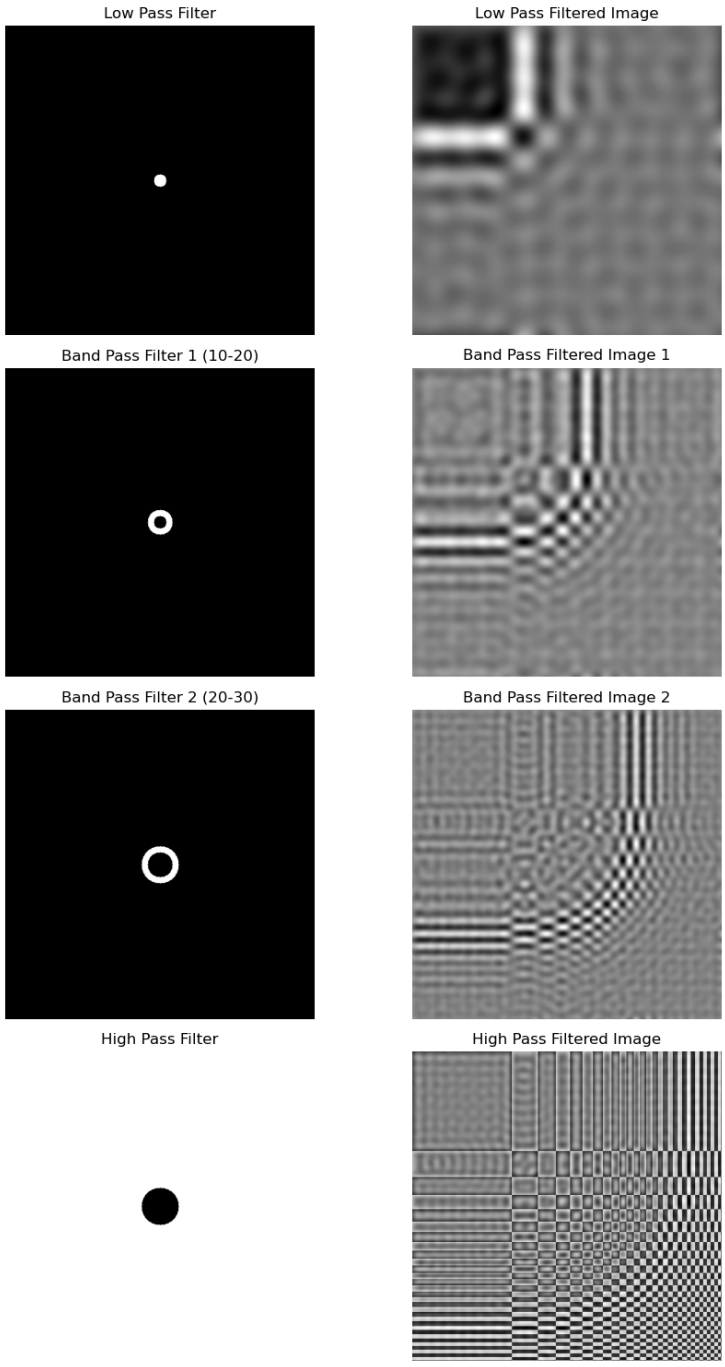

Figure 2: Filter and its Filtered Image

2 QUESTION

Ideal Low Pass Filter (ILPF)

Filter Shape: The ILPF (top-left) has a sharp cutoff in the frequency domain, passing frequencies within a circular region ($D_0 = 100$) and blocking those outside.

Filtered Image: The ILPF-filtered image (top-right) shows noticeable "ringing" artifacts around high-contrast edges due to the abrupt frequency cut-off. This causes overshooting and oscillations, leading to visible distortions near edges.

Gaussian Low Pass Filter (GLPF)

Filter Shape: The GLPF (bottom-left) has a smooth, gradual transition from low to high frequencies, avoiding the sharp cutoff of the ILPF.

Filtered Image: The GLPF-filtered image (bottom-right) appears smoother and more natural without ringing artifacts. While some fine details are blurred, the overall image retains better edge quality with minimal distortions.

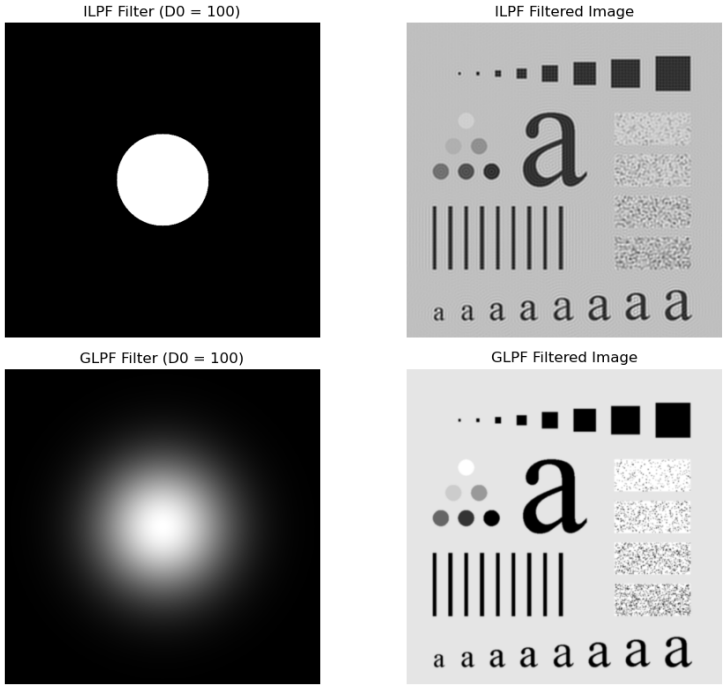

Figure 2: Filter and its Filtered Image