Assignment No. 4

Total Marks. 20

Instructions for Submission:

1. Implement all the activities using MATLAB or Python.
2. Show the code and the output results for each activity (original image + filtered/enhanced image).
3. The print should be **neat and clearly visible**. If any image or result is **not clear or blurry**, the assignment will **not be accepted**.
4. Submitted to Mehran Ahmad
5. Submission Deadline: The hard copy of this assignment must be submitted **on or before the day of the Digital Image Processing (DIP) Paper.**

Question 1: Frequency Domain Sharpening (Highpass Filtering)

Apply and analyze **sharpening filters** in the frequency domain using Python/ MATLAB. Observe how edges and details are enhanced using different high-pass filtering approaches.

Instructions:

1. Use the same grayscale image as in Assignment 03.
2. Implement and apply the following **Highpass Filters** in the frequency domain:
    - Ideal Highpass Filter (IHPF)
    - Butterworth Highpass Filter (BHPF) with order = 2
    - Gaussian Highpass Filter (GHPF)
3. Use a common cutoff frequency $D0 = 50$
4. Perform inverse FFT to reconstruct the image.
5. Display and compare:
    - Original image
    - Sharpened outputs
    - Their corresponding magnitude spectra

Analysis:

- Compare edge enhancement and noise amplification.
- Which filter gives sharp results without introducing strong artifacts? Explain.