Write your roll number IMMEDIATELY. Attempt ALL questions. Keep your answers BRIEF as irrelevant detail would be marked negatively. Questions that require pseudo-code should be answered ONLY with readable pseudo-code, no descriptions are necessary. Start answering ON your question paper (at the back as well) and attach additional sheets (with you ROLL NUMBER atop each sheet and sheet number) as necessary. If you have any issues, raise your hand.

1. What is the value of different low pass filters at \( D(u,v) = D_0 \)? Compare this value to conclude which filter is better at attenuation at the cutoff frequency. [4]

2. What conditions should be followed to avoid wraparound error in 2D convolution for an M by N image and a P by Q filter? [4]

3. Derive a method for updating the 3 by 3 convolution result of a Laplacian filter instead of having to re-compute at each pixel. Your method should take the minimum number of computations possible to compute the response at adjacent pixels. [6]

4. What affect would the spatial filter in figure b have on an image generated using the pattern in figure a repeated along the vertical and horizontal direction? [4]

\[
\begin{bmatrix}
1 & 0 & 1 & 0 & 1 \\
0 & 1 & 0 & 1 & 0 \\
1 & 0 & 1 & 0 & 1 \\
0 & 1 & 0 & 1 & 0 \\
1 & 0 & 1 & 0 & 1 \\
\end{bmatrix}
\]

\[
\begin{bmatrix}
1 & 0 & 1 \\
0 & 1 & 0 \\
1 & 0 & 1 \\
\end{bmatrix}
\]

Figure a

5. In what case(s) does the averaging filter produce a response equal to the median filter as well as the min-filter and max-filter? [2]

6. Show that the origin of the 2D Fourier transform contains the lowest frequency hence average of the image. [4]

7. The transformation function for histogram equalization of an image is an identity transform. What conclusion can be made about the image? [4]

8. What is the affect of not properly aligning the images when performing image averaging along a number of images? [2]