EE4211 Assignment 1

Question 1a:

$$output = \frac{1}{9} \times (2 + 7 + 4 + 6 + 5 + 1 + 5 + 1 + 4) = 3.89$$

Question 1b:

$$output = median(1, 1, 2, 5, 5, 5, 6, 7, 7) = 5$$

Question 1c:

$$output = 1 \times (4 + 5 + 2 + 3 + 6 + 2 + 7 + 5) - 8 \times 1 = 26$$

Question 1d:

i	0	1	2	3	4	5	6	7
h_i	2	4	5	2	3	3	3	3

Question 1e:

i	0	1	2	3	4	5	6	7
h_i	$^2/_{25}$	$^4/_{25}$	$^5/_{25}$	$^2/_{25}$	$^3/_{25}$	$^3/_{25}$	$^3/_{25}$	$^3/_{25}$
C_i	$^2/_{25}$	$^6/_{25}$	$^{11}/_{25}$	$^{13}/_{25}$	$^{16}/_{25}$	$^{19}/_{25}$	$^{22}/_{25}$	$^{25}/_{25}$
$7C_i$	1	2	3	4	4	5	6	7

Equalized image

y\x	0	1	2	3	4
0	4	7	6	3	1
1	3	3	6	1	2
2	4	5	3	7	4
3	4	2	6	5	2
4	3	7	5	2	4

i	0	1	2	3	4	5	6	7
h_i	$^0/_{25}$	$^2/_{25}$	$^4/_{25}$	$^5/_{25}$	$^5/_{25}$	$^3/_{25}$	$^3/_{25}$	$^3/_{25}$

Question 2:

Image A – Spectrum 1: a fast-varying image has high frequency contents.

Image B – Spectrum 2: a slow-varying image has low frequency contents.

Image C – Spectrum 4: strong directional features result in orthogonal lines in Fourier.

Image D – Spectrum 3: a periodic pattern results in isolated points in Fourier.

Image E – Spectrum 5: a fast-varying image has higher frequency contents.

Question 3a:

$$g(x,y) = \frac{1}{4}\big(f(x,y+1) + f(x+1,y) + f(x-1,y) + f(x,y-1)\big)$$

$$G(x,y) = \frac{1}{4}\left(e^{\frac{j2\pi}{N}} + e^{\frac{j2\pi u}{M}} + e^{\frac{-j2\pi u}{M}} + e^{\frac{-j2\pi v}{N}}\right)F(u,v)$$

$$= H(u,v)F(u,v)$$

$$\because H(u,v) = \frac{1}{2}\left(\cos\left(\frac{2\pi u}{M}\right) + \cos\left(\frac{2\pi v}{N}\right)\right)$$

Question 3b:

From $H(u,v) = \frac{1}{2}\left(\cos\left(\frac{2\pi u}{M}\right) + \cos\left(\frac{2\pi v}{N}\right)\right)$, u range from 0 to M, so the value for $\cos\left(\frac{2\pi u}{M}\right)$ will be 1 when $u = M$ and -1 when $u = {}^{M}/_{2}$, and similar when considering v. The amplitude of the filter decreases as the distance from the origin of the filter decrease, which is a characteristic of a lowpass filter.

Question 4:

Codes:

```
%% ini
clc;
clear;
close all;

%% laplacian transform
Image = imread('skeleton_orig.tif');
filter1 = fspecial('laplacian', 0);

temp1 = im2double(Image);
sharpen1 = imfilter(temp1, filter1);
sharpen2 = imsubtract(temp1, sharpen1);

%% sobel transform
filter2 = fspecial('sobel');
sharpen3 = imfilter(temp1, filter2);

%% average 5x5 smoothing on sobel imag
filter3 = 1/ (5. ^2)*ones (5);
sharpen4 = imfilter(sharpen3, filter3);

%% product of smoothing and laplacian transform
product1 = immultiply(sharpen2, sharpen4);

%% add the original image and product
sharpen5 = imadd(temp1, product1);

%% gamar transform
gamma1 = 0.5;
sharpen6 = imadjust(sharpen5,[],[],gamma1);

figure;
subplot(1,2,1);imshow(Image); title('Orginal');
subplot(1,2,2);imshow(sharpen6);title('Enhanced Image');
```

The original image and the enhanced