Digital Image Processing
Course Code: CSE395
Spring Semester Exam.

BME Program - Level 300
Exam Date: 31-3- 2018
Allowed Time: 1 Hour

Attempt all questions. Assume any missed data. Full mark is 20

Q.1) Give a *detailed answer* to each of the following questions: **[12 Marks]**

i. *Define each of the following terms:*

image restoration – spatial resolution – bit planes

ii. *"We can perform lightening or darkening of an image by addition, subtraction, multiplication, and division"*. Sketch the characteristics of a grey-scale image if we add 128 and if we divide by 2. Give MATLAB command required for this operation.

iii. *"Suppose we wish to convolve an image M with a spatial filter S"*. Write the main steps proposed by the convolution theorem to get the result.

iv. *Define the following terms for an image:*

frequency - high frequency component – low-pass filter (give a numeric example).

Q.2.a) Given a 5x5 image '*X*' and a mask '*H*' given by:

$$X = \begin{bmatrix} 15 & 12 & 175 & 14 & 15 \\ 14 & 16 & 170 & 15 & 15 \\ 18 & 17 & 170 & 15 & 15 \\ 17 & 18 & 175 & 14 & 14 \\ 18 & 17 & 170 & 14 & 14 \end{bmatrix}, \qquad H = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

Apply the filter to the image? Adjust all values to the range [0 – 255]. Select a threshold to transform the output image into a binary one **[6 Marks]**

Q.2.b) Suppose a 3-bit grey-scale image has the following grey values distribution:

Grey scale	0	1	2	3	4	5	6	7
Frequency	60	30	80	250	210	160	190	20

i. Sketch the histogram of this image. What do you expect about the image appearance?

ii. Use histogram equalization to improve the image. Sketch the result. **[6 Marks]**

☺ ***Best wishes*** ☺

Assoc. Prof. Hossam El-Din Moustafa

" Digital Image Processing "
Midterm - model answer
" 2018 "

Q1)

i. Define each of the following terms :-

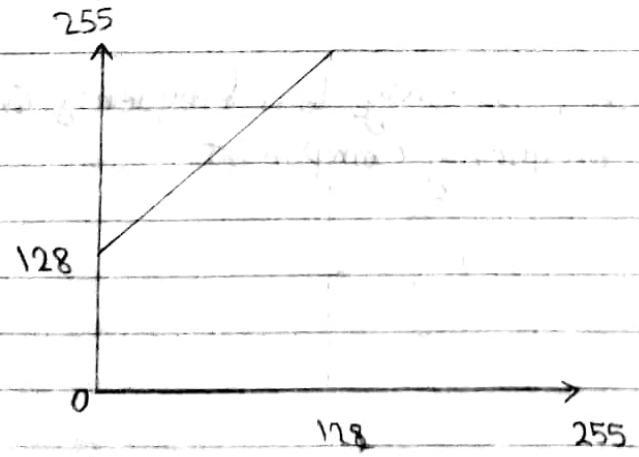
* **Image restoration** : Concerns on removing or reducing the degradation of an image such as noise by :
  - removing the blur.
  - " the added noise.
  - " the distortion.

* **spatial resoultion** : The density of the pixels in the image

* **bit planes** : each gray image can transform to a group of binary image called bit planes.

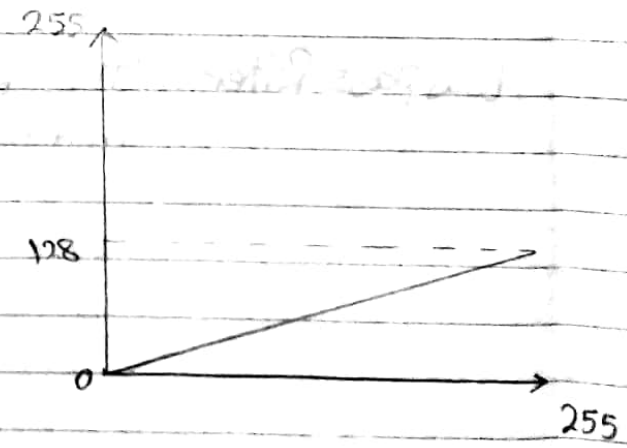
ii-

For adding 128 :-



y = imadd (x, 128);

For dividing by 2 :-



y = imdivide (x, 2);

iii. The main steps of Convolution :

1) pad Zeros of the mask (S) to be the same size of the image (M)
   ∴ filter will be (S').
2) Make DFT for the mask and the image
   F(M) & F(S).
3) Make element by element production
   F(M). F(S')
4) Take the inverse FT
   $F^{-1}(F(M).F(S'))$
   $M * S = F^{-1}(F(M).F(S'))$
   $F(M*S) = F(M).F(S')$.

iv. Define the following terms for an image :

* Frequency :- A measure of the amount by which the grey scale values change with adistance.

* High Frequency Component :- The large change in the grey scale over the small distance.

* Low pass filter :- The filter which pass only low frequency component and reject high frequency component.

Ex : $H = \frac{1}{a}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$.

Q2) a)

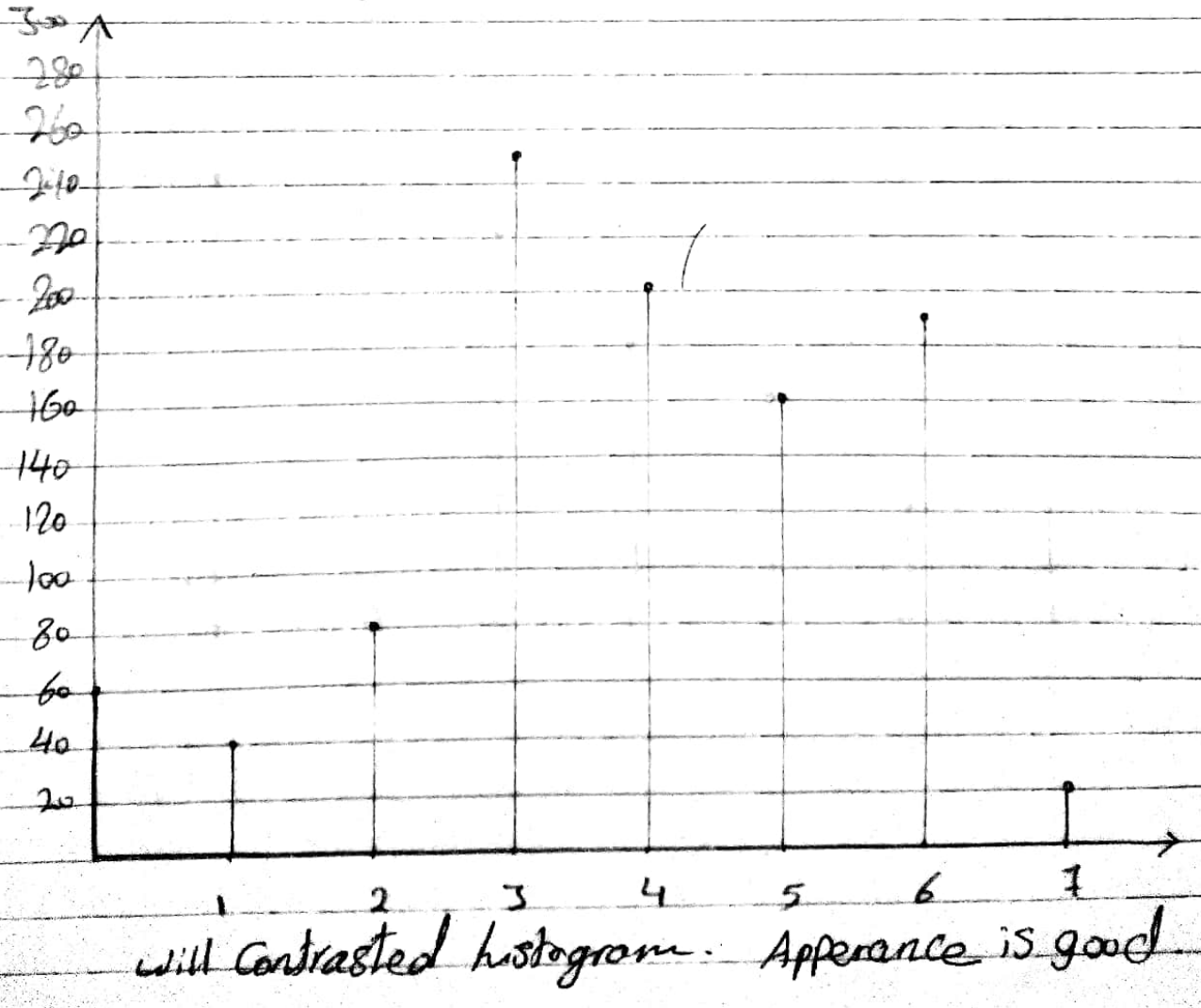
$$\begin{bmatrix} 468 & -1 & -470 \\ 466 & -7 & -471 \\ 462 & -9 & -472 \end{bmatrix}$$

Apply athreshold $\begin{bmatrix} 255 & 0 & 0 \\ 255 & 0 & 0 \\ 255 & 0 & 0 \end{bmatrix}$

∴ The binary image will $\begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$

b)

i- Sketch the histogram:



Will Contrasted histogram. Apperance is good

ii- Histogram equalization.

i	n_i	Σn_i	$\frac{7}{1000} \Sigma n_i$	Rounded value
0	60	60	0.42	0
1	30	90	0.63	1
2	80	170	1.19	1
3	250	420	2.94	3
4	210	630	4.41	4
5	160	790	5.53	6
6	190	980	6.86	7
7	20	1000	7	7