Mansoura University		**Final Exam. (Elective course 4)**
Faculty of Engineering		**Exam Time: 3 Hours**
Department of Electronics and		**Subject: Image Processing**
Communications Engineering		**Course code: COM 9424**
4th Year Electronics & Comm.		**Exam Date: 5-6-2013**

Attempt all questions. Assume any missed data. Full mark is 100

Q.1) Give a *detailed answer* to each of the following questions: **[48 Marks]**

i. *"Image processing involves changing the nature of an image to satisfy human and machine requirements".* Justify this statement. Give examples for each case.

ii. *"Image processing techniques have become a vital part of the modern movie production process".* If you are watching a 3D movie, "*Avatar*", for example, take note of all the image processing involved.

iii. *"Image processing operations may be divided into three classes based on the information required to perform the transformation".* Justify this statement. Give a block diagram realization for one of the three classes.

iv. *Define the following terms for an image:* frequency - high frequency component – low-pass filter (give a numeric example).

v. *"The result of applying a linear filter may be values which lie outside the range 0-255".* Suggest three different methods to overcome this problem.

vi. *"The idea of unsharp masking is to subtract a scaled unsharp version of the image from the original".* Sketch a block diagram to implement this process. Write a MATLAB program segment to enhance the edges of the image "*nado.jpg*".

vii. *"The Fourier transform is of fundamental importance to image processing".* Justify this statement. Write down the equations of the 2D discrete Fourier transform.

viii. *"Cleaning an image corrupted by Gaussian noise is an important area of image restoration".* Justify this statement. Suggest two different methods to reduce the effect of Gaussian noise.

ix. *"Inverse filtering may lead to errors in the filtered image".* Explain the concept of inverse filtering and the procedures that must be followed to overcome its disadvantages.

x. *"Thresholding can be useful in many situations".* Justify this statement. In which situations will adaptive thresholding be applied?

xi. Define "*edge*" of an image. What is the main difference between "*ramp edge*" and "*step edge*"? Give an example for a first-order and a second-order edge detectors.

xii. *"A color model is a method for specifying colors in some standard way".* Discuss the main three color models that are commonly used. Write down the MATLAB commands which can be used to transform between these models.

Q.2.a) Use *MATLAB* to read a color image "*yoyo.tif*". Add 10% salt and pepper noise to the image. Attempt to remove noise using:

- Average filtering (Size 7x7).
- Median filtering (size7x7). Comment on results
- Obtain the edges of the original color image using "sobel" operator. **[10 Marks]**

Q.2.b) Given a 5x5 image **[10 Marks]**

$$\begin{bmatrix} 150 & 120 & 173 & 145 & 150 \\ 140 & 165 & 170 & 150 & 148 \\ 180 & 170 & 170 & 150 & 152 \\ 170 & 185 & 175 & 145 & 147 \\ 200 & 170 & 170 & 145 & 147 \end{bmatrix}$$

Apply a low-pass filter to the image. How can you overcome the problem of vanishing edges?

Q.2.c) Derive the parametric form of a straight line in an image. Use the Hough transform to detect the strongest lines in the binary image shown below. **[10 Marks]**

x

y	0	1	2	3	4	5	6
0	0	0	0	0	0	1	0
1	1	0	0	0	0	0	0
2	0	1	0	0	0	1	0
3	0	0	1	0	0	0	0
4	0	0	0	1	0	0	0
5	0	0	0	0	1	1	0
6	0	0	0	0	0	1	0

Q.3.a) Consider the following 3-bit grey-scale image has the following grey values distribution.

Grey scale	0	1	2	3	4	5	6	7
Frequency	600	300	800	2500	2100	1600	1900	200

i. Sketch the histogram of this image. What do you expect about the appearance of this image?
ii. Equalize this histogram. Sketch the result
iii. Determine the entropy of the image.
iv. Construct a Huffman code for the image.
v. Determine the average bits/pixel for your code. Comment on results.
vi. Decode the following sequence {11011100000100111110} **[20 Marks]**

Q.3.b) Determine the bit planes for the 4-bit grey-scale image shown below. Encode the image using RLE using *two* different methods. Do you think that the use of grey code would improve the result? Justify your answer. **[10 Marks]**

$$\begin{bmatrix} 09 & 08 & 08 & 08 \\ 09 & 08 & 09 & 08 \\ 08 & 09 & 08 & 09 \\ 08 & 09 & 08 & 09 \end{bmatrix}$$

My best wishes to all of you!

Asis. Prof. Hossam El-Din Moustafa