ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION **SUMMER SEMESTER, 2018-2019**

DURATION: 3 Hours **FULL MARKS: 150**

CSE 6265: Advanced Digital Image Processing

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **7 (seven)** questions. Answer **any 6 (six)** of them including **Question no. 3**.

Figures in the right margin indicate marks.

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1. a) Briefly describe the Image Degradation/Restoration model. How do you estimate the noise model parameters that follows a Uniform distribution? 3+7
   b) When will the Medial filter fails to remove impulse noise? 5
   c) Define the Contraharmonic mean filter. 1
      i. Explain why the filter is effective in elimination pepper noise when Q is positive. 3
      ii. Explain why the filter gives poor results when the wrong polarity is chosen for Q. 3
      iii. Discuss (for positive and negative Q) the behavior of the filter in areas of constant intensity levels. 3

2. a) Explain the CIE chromaticity diagram and how it is produced. 5
   b) Suppose the color values of an image have been modified using the transformation functions as shown in Figure 1 in its RGB color space. How can you obtain the same effect using the 5+5
      i. HSI color space
      ii. CMY color space

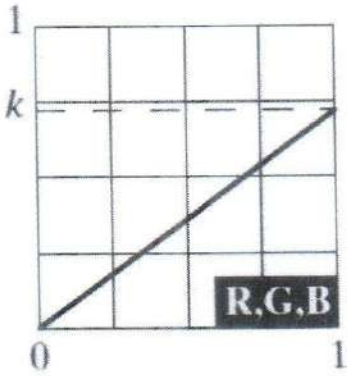

Figure 1: Color Transformation Function.

   c) Draw the general shape of the transformation functions used to correct excessive contrast in the RGB color space. Explain how that transformation function will reduce excessive contrast. 10

[Mandatory]

3. a) How is the Approximation and Prediction Residual Pyramids generated in a multi-resolution analysis of digital image? Draw necessary figures and block diagrams. 10
   b) What is perfect reconstruction filter in Subband coding? What conditions are required for building perfect reconstruction filters? 1+4
   c) Briefly describe generalized Wavelet transform in one dimension. Also give an example of a one dimensional function being represented in the approximation and wavelet spaces. 10
4. a) Write short notes on the following morphological operations: 3×5
      i. Convex Hull
      ii. Morphological Gradient for gray-scale images
      iii. Thinning

b) What would happen in binary erosion and dilation if the structuring element is a single point, valued 1? Justify your answer. 5

c) Suppose your image suffers from non-uniform illumination and is affecting the segmentation process using thresholding. How can you correct this illumination effect before thresholding? 5

5. a) Suppose that a flat area with center at (x_0, y_0) is illuminated by a light source with intensity distribution $i(x,y) = Ke^{-[(x-x_0)^2+(y-y_0)^2]}$. Assume for simplicity that the reflectance of the area is constant and equal to 1.0, and let K=255. If the resulting image is digitized with k bits of intensity resolution, and the eye can detect an abrupt change of eight shades of intensity between adjacent pixels, what value of k will cause visible false contouring? 8

b) Show that 2-D filtering with separable, symmetric filters can be computed by (1) computing 1-D convolution along the individual rows (columns) of the input, followed by (2) computing 1-D convolution along the columns (rows) of the result from step (1). 10

c) Develop an algorithm for converting a one-pixel-thick m-path to a 4-path. 7

6. a) Write short notes on the following filters: 5+5
   i. Gaussian Lowpass Filter
   ii. Band Reject Filter

b) Define the Butterworth highpass filter. Now use a Butterworth highpass filter to construct a Homomorphic filter. 2+6

c) Suppose your image suffers from period noise and noise parameters are known. How can you remove such noise effects? Draw your filter and explain how it can remove such noises? 7

7. Suppose you are contacted by a fluids company that wishes to automate bubble-counting in certain processes for quality control. The company has solved the imaging problem and can obtain 8-bit images of size 700×700 pixels, such as the one shown in Figure 2. Each image represents an area of 7 cm^2. The company wishes to do two things with each image: (1) Determine the ratio of the area occupied by bubbles to the total area of the image, and (2) count the number of distinct bubbles. Based on the material you have learned up to this point, propose a solution to this problem. In your solution, make sure to state the physical dimensions of the smallest bubble your solution can detect. State clearly all assumptions that you make and that are likely to impact the solution you propose. 25

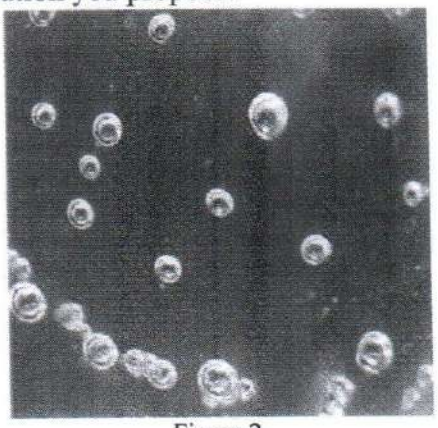

Figure 2.