B.Sc. Engg. CSE 7th Semester
B.Sc. Engg. SWE 5th Semester

27 February 2020 (Morning)

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

MID SEMESTER EXAMINATION — **WINTER SEMESTER, 2019-2020**

DURATION: 1 Hour 30 Minutes — **FULL MARKS: 75**

CSE 4733 / CSE 4561: Digital Image Processing

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

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) What are the illumination and reflectance components of an image formation model? How is the intensity level defined from this model? 2+5

   b) When and how do you use *bicubic interpolation* in digital image processing? 10

   c) What is false contouring? 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? 2+6

2. a) Develop an algorithm for converting a one-pixel-thick *8*-path to a *4*-path. 7

   b) Suppose your monitor has a gamma error when displaying an image on it. How can you correct this gamma error? Mathematically explain it for color images. 8

   c) An image has the gray level histogram $p_r(r)$ shown in Figure 1. It is desired to transform the gray levels of this image so that it will have the specified histogram $p_z(z)$ provided by equation (1.2). Assume continuous quantities and find the transformation function (in terms of r and z) that will accomplish this. 10

$$p_r(r) = 2 - 2r \qquad (1.1)$$

$$p_z(z) = 2z \qquad (1.2)$$

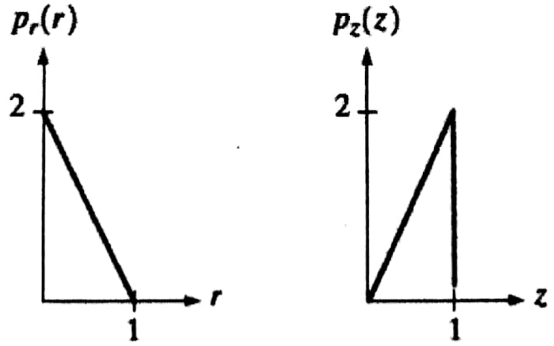

Figure. 1

3. a) Show that 2-D filtering with separable, symmetric filters can be computed by first computing 1-D convolution along the individual rows (columns) of the input, followed by computing 1-D convolution along the columns (rows) of the result from the first step. 8

   b) "Gradient mask is not an isotropic mask but gradient magnitude is" – Briefly explain why. 5

   c) Explain the working principle of *unsharp masking*. Design a single mask with which if you perform spatial filtering, the output will be sharpening with *unsharp mask* including a weight factor k. 6+6

4. a) 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. 5

b) Suppose the color values of an image have been modified using the transformation functions as shown in Figure 2 in its RGB color space. How can you obtain the same effect using the 3+3

i. HSI color space

ii. CMY color space

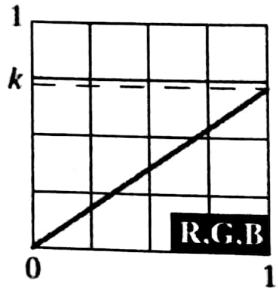

Figure 2: Color Transformation Function.

c) If a smoothing filter is applied directly on a color image, what difference will it make in contrast to the output where the filter is applied separately on each RGB color channel? 5

d) In an automated assembly application, three classes of parts are to be color coded in order to simplify detection. However, only a monochrome TV camera is available to acquire digital images. Propose a technique for using this camera to detect the three different colors. 9