

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**

**Department of Computer Science and Engineering (CSE)**

**MID SEMESTER EXAMINATION**

**WINTER SEMESTER, 2017-2018**

**DURATION: 1 Hour 30 Minutes**

**FULL MARKS:75**

**CSE 4733: 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.

1. a) Define the following terms: 2×5
    - i. Digital Image
    - ii. Luminance
    - iii. Intensity Resolution
    - iv. Spatial Resolution
    - v. False Contouring
  - b) Describe a simple image formation model in the 2D spatial domain. 5
  - c) In order to generate digital images from sensed data, *sampling* and *quantization* are two important processes. How do these two operations affect the size and color information of an image? 10
  
  2. a) When and how do you use *bicubic interpolation* in digital image processing? 8
  - b) Consider the two sub-regions in an image,  $R_i$  and  $R_j$ , shown in Figure 1. For  $V = \{1\}$ , determine whether these two subsets are (i) 4-adjacent, (ii) 8-adjacent, or (iii) m-adjacent. Explain your answers. 9
- $$\begin{array}{ccc}
 1 & 1 & 1 \\
 1 & 0 & 1 \\
 0 & 1 & 0 \\
 0 & 0 & 1 \\
 1 & 1 & 1 \\
 1 & 1 & 1
 \end{array}
 \left. \begin{array}{l} \\ \\ \\ \\ \\ \end{array} \right\} \begin{array}{l} R_i \\ \\ \\ R_j \\ \\ \end{array}$$

Figure 1.
- c) When is an operation  $H$  called linear? Show that the median operator is not linear. 8
  
  3. a) What conditions should an intensity transformation function  $T()$  fulfill? What happens if they fail? 3+4
  - b) Draw a single intensity transformation function for spreading the intensities of a gray-scale image so the lowest intensity is 0 and the highest is  $(L-1)$ . Here  $L$  is the number of intensities possible. Give the mathematical definition of your transformation function. 4+4
  - c) Explain with appropriate figures, why the discrete histogram equalization technique does not, in general, yield a flat histogram. 10
  
  4. a) Give the mathematical equation representing the convolution of a filter  $w(x,y)$  with an image  $f(x,y)$ . Show the results of applying a weighted average filter on an image of size  $5 \times 5$  pixels. Explain some of the convolution responses with that filter. 10

- b) What is high-boost filtering and why is this filter used? Can you change this filter to perform exactly as unsharp masking? Explain the working principle of unsharp masking.
- c) How was the Sobel mask designed for computing the gradient of an image?

10

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