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

Date: 24 June 2021

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

MID SEMESTER EXAMINATION — **WINTER SEMESTER, 2020-2021**

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 **3 (three)** questions. Answer all **3 (three)** of them.

Figures in the right margin indicate marks and corresponding CO & PO are written in brackets.

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1. a) Ultra High-definition television (4K UHD) generates images with 2160 horizontal TV lines interlaced (where every other line is painted on the tube face in each of two fields, each field being of a $1/60^{th}$ of a second in duration). The width-to-height aspect ratio of the images is 16:9. The fact that the number of horizontal lines is fixed determines the vertical resolution of the images. A company has designed an image capture system that generates digital images from UHDTV images. The resolution of each TV (horizontal) line in their system is in proportion to vertical resolution, with the proportion being the width-to-height ratio of the images. Each pixel in the color image has 24 bits of intensity resolution, 8 bits each for a red, a green, and a blue plane. These three 'primary' images form a color image. How many bits would it take to store a 1-hour UHDTV movie? **5** [CO1, PO1]

   b) What is intensity resolution? Suppose your gray-scale image contains gradual increase or decrease of intensity values in smooth regions. What kind of side effects can you have if there is insufficient intensity resolution to represent smooth regions? Explain the reason behind it. **2+8** [CO2, PO2]

   c) Define 4-connectivity and m-connectivity with figures. Develop an algorithm for converting a one-pixel-thick *m*-path to a *4*-path. **3+7** [CO3, PO3]

2. a) When is an operation H called linear? The max, α, of a set of numbers is such a number which is the highest value among all. For example, the max of the set of values {2, 3, 8, 20, 21, 25, -31} is 25. Show that an operator H that computes the maximum of a subimage area, is nonlinear. **2+6** [CO1, PO1]

   b) What is a contrast stretching transformation? Show how such transformation function can expand a narrow range of intensity levels of an image to a much higher range of intensity. Justify your answer with the help of an intensity mapping function. **2+5** [CO1, PO1]

   c) Design a set of intensity-slicing transformations capable of producing all the individual bit planes of an 8-bit monochrome image. **10** [CO3, PO3]

3. a) Differentiate between Histogram Equalization (HE) and Histogram Specification (HS). **8** [CO2, PO2]

   b) Show that applying a $n \times n$ Box filter repeatedly on an image is equivalent to applying a Weighted Average filter of size $m \times m$, where $m > n$. Demonstrate with an example from 1-D image values. **10** [CO1, PO1]

   c) Create a single mask with which if you perform spatial filtering once, the output will be equal to sharpening with Laplacian fitler. **7** [CO3, PO3