

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

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

**SEMESTER FINAL EXAMINATION**

**WINTER SEMESTER, 2017-2018**

**DURATION: 3 Hours**

**FULL MARKS: 150**

**CSE 4733: Digital Image Processing**

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

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

1. a) Differentiate between the Additive and Subtractive color systems with examples. 5  
 b) Write short notes on the following color models: 5×2
  - i. HSI
  - ii. RGB safe color
- c) Suppose John and Joe both carried out an image smoothing operation on the same color image. John applied the box filter directly on the RGB color vector values, whereas Joe separated each color channels and applied the filter individually on each channel. Will John and Joe get the same output? Explain your answer mathematically. 7
- d) Why do we need a separate Black channel along with the CMY color model? 3
2. 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. 10  
 b) Suppose the color values of your image are corrupted by separately adding Gaussian noise of zero mean and  $\sigma$  variance with each RGB color channels. Now if the same image is analyzed using HSI components, which channels will show more or less color degradation levels. Explain why. 9  
 c) How can you implement the Highboost filtering operation for color image? 6
3. a) Describe the working principle of the following morphological operations: 4×2
  - i. Opening for Binary image
  - ii. Closing for Gray-scale image
- b) Sketch the result of applying the hit-or-miss transform to the image and structuring element shown in Figure 1. Indicate clearly the origin and border you selected for the structuring element. 7

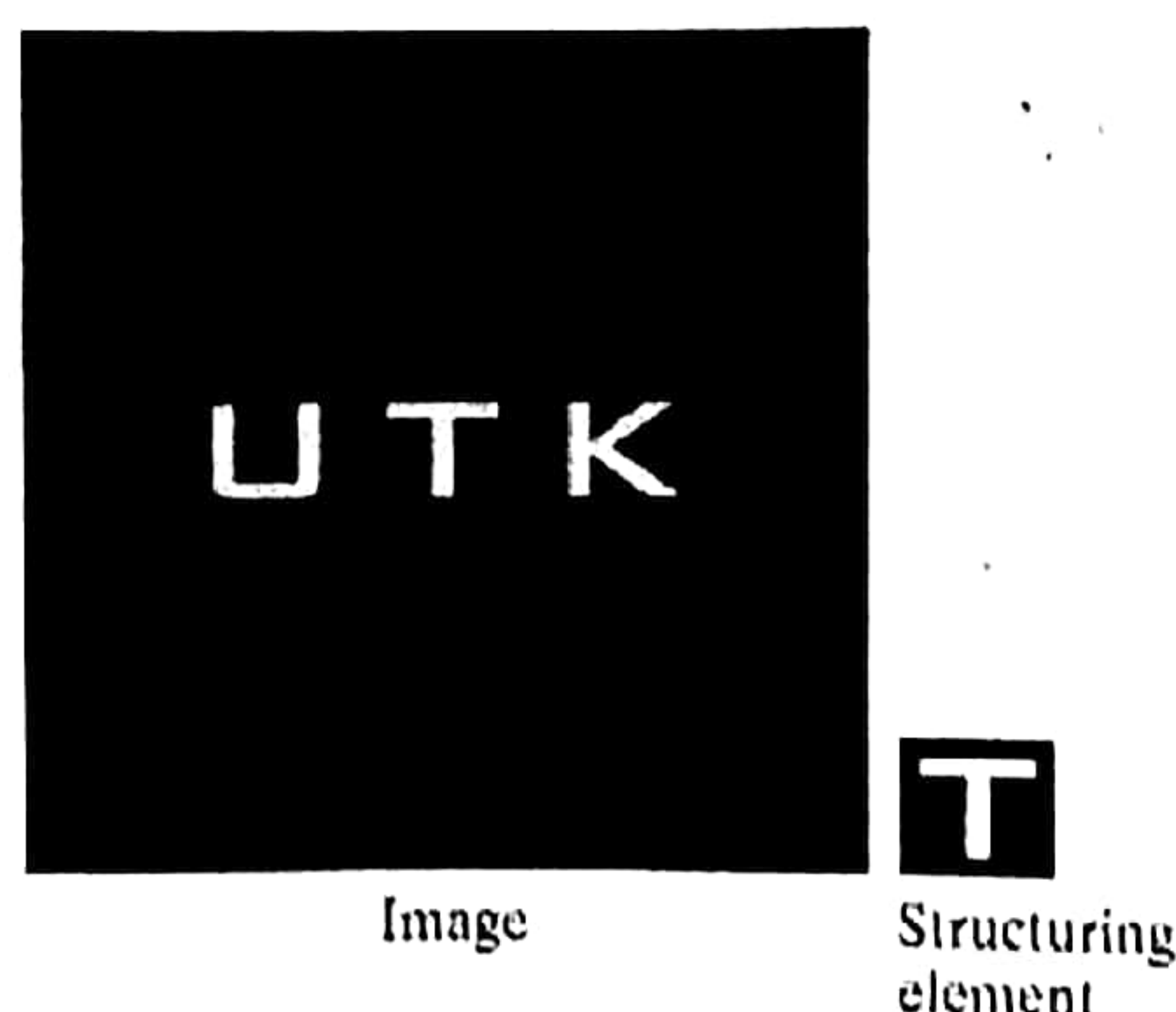


Figure 1.

- c) Opening or Closing with circular structuring element (SE) produces round corners which were sharp beforehand. Describe when and why these inward and outward sharp corners are rounded. 5+5



4.
    - a) How were the weight coefficients chosen for the Prewitt Gradient masks? 5
    - b) Describe the Hough Transform for detecting shapes represented with parameter equations. 10
    - c) Explain when and why the Hough mapping of a single point in an image will produce a straight line at  $\rho=0$  for all values of  $\theta$  in the  $\rho\theta$ -accumulation space. 10
  
  5.
    - a) What does the preprocessing step do before a filtering operation in the Fourier Domain? 5
    - b) Why do you observe ripple or ringing effects in the output image for Ideal Filters? 5
    - c) Write short notes on the following filters: 5×2
      - i. Gaussian Highpass Filter (IHPF)
      - ii. Butterworth Lowpass Filter (BLPF)
    - d) If the text in the image given in Figure 1 shift their position vertically up by  $n$  pixels, what changes would you see in its spectrum values at different frequency components? 5
  
  6.
    - a) Show that subtracting the Laplacian from an image is proportional to unsharp mask. Use the definition for the Laplacian with a center coefficient of negative sign. 10
    - b) How is unsharp masking similar or dissimilar to image sharpening with Laplacian filter? 5
    - c) Give a  $3 \times 3$  mask for performing unsharp masking in a single pass through an image. Assume that the average image is obtained using the box filter. 10
  
  7.
    - a) Why does a gray-scale image always have an average intensity of mid-range after histogram equalization (HE)? 5
    - b) Exponentials of the form  $e^{-\alpha r^2}$ , with  $\alpha$  a positive constant are useful for constructing smooth intensity transformation functions. Start with this basic function and construct or define transformation function  $T(r)$  having the general shape shown in Figure 2. The constants shown are input parameters, and your proposed transformations must include them in their specification. 10
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- Figure 2.
- c) How is HE adapted for local enhancement? Why can it bring out more details than its global counterpart? 10
  
  8.
    - a) Develop an algorithm for converting a one-pixel-thick 8-path to a 4-path. 10
    - b) What is isotropic filter? Prove that Gradient mask is not isotropic. 2+5
    - c) In an 8-bit grey scale image, a specific bit-plane values been forcefully inverted. How can you find out which bit-plane has been inverted? 8