



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

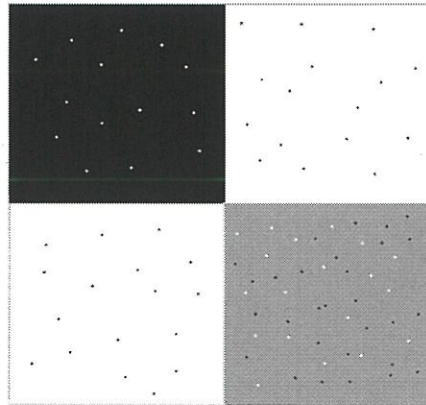
**FINAL EXAMINATION  
SEMESTER II  
SESSION 2021/2022**

COURSE NAME : IMAGE PROCESSING  
COURSE CODE : BEJ 42903  
PROGRAMME CODE : BEJ  
EXAMINATION DATE : JULY 2022  
DURATION : 3 HOURS  
INSTRUCTION 

1. ANSWERS **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS A **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**.

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

**Q1** You are given an image  $g(x,y)$  as **Figure Q1**. It shows a grayscale image corrupted by salt and pepper noise. The black, grey and white colour pixels are represented by 0, 128 and 255, respectively. You are required to remove the noise in this image by using **threshold technique** to produce an output image,  $h(x,y)$ .



**Figure Q1**

- (a) Provide a flowchart for the whole process. (8 marks)
- (b) Write detail explanation on each process in **Q1(a)**. Provide as well the threshold equations and values for your denoising. You can use images/figures to support your explanations. (22 marks)

**Q2** Suppose we have a 1-D row matrix (1x8) for a grayscale image,  $V$  as shown in **Figure Q2**.

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| ? | ? | ? | ? | ? | ? | ? | ? |
|---|---|---|---|---|---|---|---|

**Figure Q2.** Original image,  $V$

- (a) Propose a new set of pixel values for  $V$  using your IC numbers combination. Please provide your IC number at the beginning of your answer. (1 mark)
- (b) Perform a wavelet domain transform to  $V$  using 1-D Discrete Wavelet Transform (DWT) at decomposition Level 3,  $d_3$ . Show step-by-step calculation for your answer. (27 marks)
- (c) Perform **cut-off** to your pixel values for  $d_3$ , denoted as  $d_{3cut-off}$ . Show step-by-step calculation for your answer. (2 marks)

- (d) Perform reconstruction Level 3 for Inverse Discrete Wavelet Transform (IDWT) to get  $V_{cut-off}$ . Show step-by-step calculation for your answer. (20 marks)

- Q3** (a) Provide an example of a grayscale image represented by pixel intensity values, which sized 5 x 5 pixels. Draw a matrix as in **Figure Q3(a)** consisting of the combination of any integer from your Identity Card Number (NRIC), **number “0” and number “255”**. Please provide your IC number at the beginning of your answer.

|     |   |     |   |   |   |   |
|-----|---|-----|---|---|---|---|
|     |   | $y$ |   |   |   |   |
|     |   | 1   | 2 | 3 | 4 | 5 |
| $x$ | 1 | ?   | ? | ? | ? | ? |
|     | 2 | ?   | ? | ? | ? | ? |
|     | 3 | ?   | ? | ? | ? | ? |
|     | 4 | ?   | ? | ? | ? | ? |
|     | 5 | ?   | ? | ? | ? | ? |

**Original image,  $f(x,y)$**

**Figure Q3(a)**

(2 marks)

- (b) **Figure Q3(b)** shows  $3 \times 3$  structuring elements,  $B$ . Find the output pixel value of **Figure Q3(a)** and  $B$  for pixel location at location at (1,1) and (1,5) **without using padding technique** for the dilation method. **Perform cut-off** to your final answer.

|     |   |     |   |   |
|-----|---|-----|---|---|
|     |   | $y$ |   |   |
|     |   | 1   | 2 | 3 |
| $x$ | 1 | 1   | 2 | 3 |
|     | 2 | 4   | 5 | 6 |
|     | 3 | 7   | 8 | 9 |

**$B$**

**Figure Q3(b)**

(18 marks)

**-END OF QUESTIONS -**

