

CONFIDENTIAL



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

COURSE NAME : IMAGE PROCESSING
COURSE CODE : BIM 33203
PROGRAMME CODE : BIM
EXAMINATION DATE : JULY / AUGUST 2023
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

TERBUKA

CONFIDENTIAL

Q1 Image compression techniques reduce the number of bits required to represent an image by certain procedures, mainly to reduce the cost of storage and transmission.

(a) With respect to this branch of image processing, describe **TWO (2)** major differences of why data is not equal to information.

(4 marks)

(b) Consider a simple 8-bit image as follows:

11	97	97	191	234	234	234	234
11	97	97	191	234	234	234	234
11	97	97	191	234	234	234	234
11	97	97	191	234	234	234	234

Construct a probability table and calculate the entropy estimation of the image.

(8 marks)

(c) Draw a functional block diagram of a general image compression system.

(3 marks)

(d) Based on the data of the original source below, rearrange the values accordingly and construct a source reduction table using forward-pass Huffman coding.

$a_1 = 0.02; a_2 = 0.125; a_3 = 0.25; a_4 = 0.3; a_5 = 0.25; a_6 = 0.055$

(10 marks)

Q2 (a) Detection of discontinuities is part of image segmentation techniques. Describe the **THREE (3)** basic types of gray-level discontinuities.

(3 marks)

(b) Canny Edge Detection algorithm is one of the most strictly defined methods that provide good and reliable detection of edges in an image. List down **FIVE (5)** processing steps to extract edges on an image by using this technique.

(5 marks)

- (c) Region splitting and merging is another division in image segmentation, which in principle with certain conditions, subdivide the entire region into smaller regions and integrate two adjacent regions, correspondingly. With respect to quadtree processing, briefly explain this technique. Your answer should include an illustration of a partitioned image and its corresponding quadtree.

(7 marks)

- (d) By using Image Processing Toolbox™ (IPT) in MATLAB, `coins.png` as an input image and `activecontour` as the main function, explain how you could segment the coins accurately. Describe your answer in the form of pseudocode only, starting from reading the image file.

(10 marks)

Q3 Morphology in image processing is a set of mathematical frameworks applied mostly for pre-processing, enhancing object structure, segmentation, and quantitative description for regions of interest.

- (a) Describe opening and closing morphological operations. Your answer must include the definition, process, and formulation.

(6 marks)

- (b) Based on the input image in **Figure Q3**, draw the output image for each of the basic morphological algorithms listed below. The default structuring element for these operations is given as `strel('rectangle', [10 10])`.



Figure Q3

- (i) Dilation (2 marks)
 - (ii) Erosion (2 marks)
 - (iii) Boundary extraction (2 marks)
 - (iv) Convex hull (2 marks)
 - (v) Skeleton (2 marks)
- (c) You are provided with a grayscale image of `coins.png`. List down all the commands to fill holes in this input image, including displaying the result. (4 marks)

Q4 Object recognition is one of the major domains in image processing. It is the task of locating and identifying objects in an image or sequence of images (video), with matching (recognising) a specific object or scene as the goal of instance-level (real-time) of this domain.

- (a) Distinguish between class and classification. Your answer should include an example for each of these clusters. (4 marks)

- (b) Suppose you have an image of a cluttered scene, `clutteredDesk.jpg`, and you want to detect a particular object of which you have a separate image, `stapleRemover.jpg`. You will start by reading the reference image containing the object of interest into MATLAB® via this command:

```
boxImage = imread('stapleRemover.jpg');
```

Next, you will read the target image containing a cluttered scene via this command:

```
sceneImage = imread('clutteredDesk.jpg');
```

List down all commands to detect and visualize 100 and 300 strongest feature points on both images of `boxImage` and `sceneImage`, respectively.

(10 marks)

- (c) Now, list all the commands used to extract feature descriptors at the points of interest in both images from **Q4(b)**.

(6 marks)

- Q5** Figure Q5 shows one of the busiest streets in London, England. As an image analyst for the London Metropolitan Police Force, you must examine and investigate the tasks required to build up surveillance and traffic monitoring frameworks. Your established framework will be used as a standard for public surveillance and traffic monitoring systems in other places throughout the United Kingdom. Elaborate your own framework based on the fundamental principles of image processing.



Figure Q5

(10 marks)

- END OF QUESTIONS -