Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	IMAGE PROCESSING
COURSE CODE	:	BIM 33203
PROGRAMME CODE	:	BIM
EXAMINATION DATE	:	JANUARY/ FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. PLEASE MAKE SURE TO CLICK "SAVE ANSWER" BUTTON FOR SUBJECTIVE QUESTIONS. OBJECTIVE QUESTIONS ARE SAVED AUTOMATICALLY.

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 For **Q1 (a) – Q1 (j)**, answer **True** or **False**.

(a) Noise reduction is obtained by blurring the image using smoothing filter.

(b) Smoothing spatial filters does not smooth the false contours.

(c) IIistograms are the basis for numerous spatial domain processing techniques.

(d) Histogram Equalisation is mainly used for contrast adjustment.

(e) Filtering is the process of accepting or rejecting certain frequency components.

(f) The expansion of PDF in uniform PDFs is Probability Density Function.

(g) A filter that passes low frequencies is band pass filter

(h) In imaging, data and information are synonymous.

(i) Error in an image is known as noise.

(j) Restoration attempts to reconstruct or recover an image that has been degraded by using a clear knowledge of the degrading phenomenon.

(10 marks)

Q2 An image has many presentation forms: on frequency domain, spatial domain and time domain. Image processing is performed in spatial and frequency domains. By providing examples of image processing problems, discuss the need to transform into a different domain and whether one domain is better than the other.

(10 marks)

Q3 Figure **Q3 shows** (a) a 3-bit image of size 5-by-5 image in the square, with x and y coordinates specified, (b) a Laplacian filter and (c) a low-pass filter.

(a)

y \ x	0	1	2	3	4
0	3	7	6	2	0
1	2	4	8	1	1
2	4	7	2	5	4
3	3	0	6	2	1
4	5	7	5	1	2

(b) Laplacian filter

0	1	0
1	-4	1
0	1	0

(c) Low pass filter

0.01	0.1	0.01
0.10	0.56	0.10
0.01	0.1	0.01

FIGURE Q3

Calculate the following:

(a) The output of a 3 x 3 mean filter at (3, 2).

(2 marks)

(b) The output of a 3 x 3 median filter at (3, 2).

(2 marks)

(c) The output of a 3 x 3 Laplacian filter shown above at (3, 2).

(2 marks)

(d) The output of a 3 x 3 low-pass filter shown above at (3, 2).

(2 marks)

Q4 (a) Explain the concept underlying the Huffman codes.

(4 marks)

(b) Decode the following encoded string using the Huffman code shown in **Figure Q4**.

Original source			Source reduction			
Symbol	Probability	Code	1	2	3	4
a_2	0.4	1	0.4 1	0.4 1	0.4 1	0.6 0
a_6	0.3	00	0.3 00	0.3 00	0.3 00	0.4 1
a_1	0.1	011	0.1 011	0.2 010	0.3 01	
a_4	0.1	0100	0.1 0100	0.1 011		
a_3	0.06	01010	0.1 0101			
a_5	0.04	01011				

FIGURE Q4

(i) 01010000101010111110100

(4 marks)

(ii) 010100111100

(2 marks)

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

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

(5 marks)

Q5 Image Processing Toolbox™ (IPT) in MATLAB is a powerful tool that provides a comprehensive set of reference-standard algorithms and workflow applications for image processing, analysis, visualization and algorithm development. IPT applications also let you perform image segmentation, image enhancement, noise reduction, geometric transformations and automate common image processing workflow.

(a) By using utbm.png as an image file, list down basic operations to display this image by using IPT in MATLAB.

(2 marks)

(b) Write the code to display the individual RGB component of the image.

(7 marks)

Q6 **Figure Q6** shows an electron microscope image of pollen, magnified approximately 700 times with its histogram.

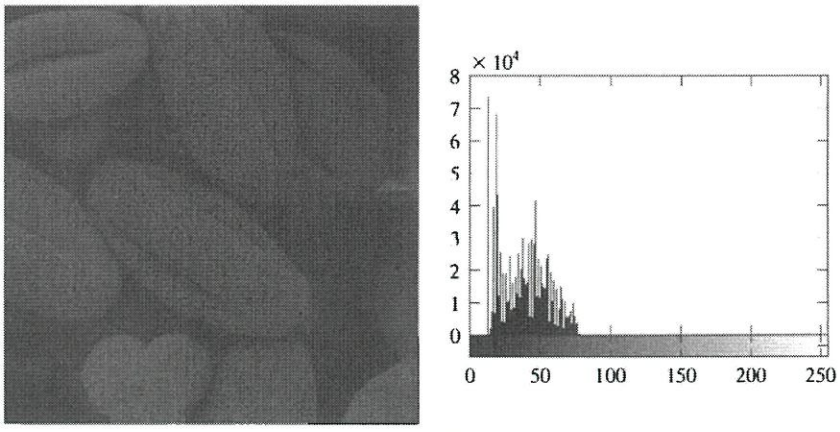

FIGURE Q6

(a) Discuss the most important features of the image in terms of needed enhancement.

(6 marks)

(b) Suggest a method to enhance the image in **Figure Q6**.

(2 marks)

(c) Write the code to enhance the image using the suggested method as answered in **Q6 (b)**. Show both the original image and the enhanced image with its histogram.

(6 marks)

Q7 **Figure Q7** shows two images, the first is the original and the second is the image that has been degraded with a salt and pepper noise.

FIGURE Q7

(a) Suggest the best filtering method to remove the salt and pepper noise with appropriate justification.

(8 marks)

(b) Write the code to remove the noise using the filter suggested in **Q7 (a)**.

(6 marks)

– END OF QUESTION –