GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Electrical, Electronic and Telecommunication Engineering

BSc Engineering Degree
Semester 4 Examination – November 2017
(Intake 33 - EE/ET)

(ET 2223) IMAGE PROCESSING

Time allowed: 3 hours 20 November, 2017

ADDITIONAL MATERIAL PROVIDED

None.

INSTRUCTIONS TO CANDIDATES

This paper contains 4 questions on 7 pages

Answer all questions.

This is a closed book examination

This examination accounts for 80% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script

All examinations are conducted under the rules and regulations of the KDU

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Question 1

a) Briefly explain how **image processing** and **computer vision** differ from each other. [5] [25 marks]

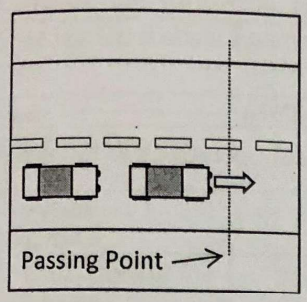
.....

.....

Suggest an image processing based approach to achieve the following tasks. Clearly mention each of the steps with a brief justification.

b) Count number of **red** cars which pass a specific point on the road, assuming the top view of the scene is captured using a fixed video camera. [10]

Your approach:



Sample Image

c) Locate the **barcode region** from a product packing box assuming the camera has been fixed to capture the upright pose of the printed side of the box. *Note that the barcode location varies from one box to another, but the size of the barcode is fixed.* [10]

Your approach:

Sample Image

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[25 marks]

Question 2

a) Give the mathematical expression of the image dilation operation. Introduce each of the terms in the expression. [5]

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.....

.....

.....

b) Compare and contrast between morphological analysis and connected component labeling (CCL) in image processing. [5]

.....

.....

.....

.....

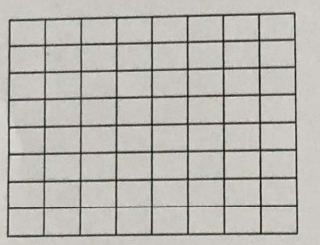
c) Show the result after applying the following morphological operations to the image I_1 using the structuring element E_1. [15]

0	0	1	0	0	0	0	0
0	1	1	1	0	0	0	0
0	0	1	1	1	0	0	0
0	1	1	1	1	1	0	0
0	0	1	0	0	0	0	0
0	0	1	1	1	0	0	0
0	1	1	1	0	0	1	0
0	0	1	0	0	0	0	0

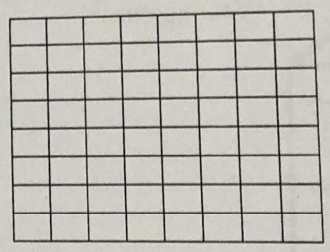
I_1

	1	
1	1	1
	1	

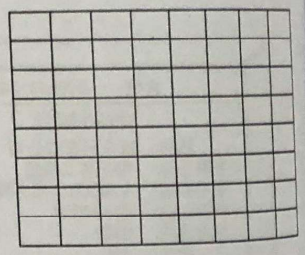
E_1



Morphological Dilation



Morphological Opening



Morphological Closing

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Question 3

[25 marks]

a) List five usages of image key-point descriptors. [5]

i. .....

ii. .....

iii. .....

iv. .....

v. .....

b) Compare the following facts about Scale Invariant Feature Transform (SIFT) and Speeded Up Robust Feature (SURF). [10]

Fact	SIFT	SURF
Key-point Detector		
Key-Point Descriptor		
Overall Speed of the Algorithm		
Invariance to Rotation		
Speed of Scale Space Construction		

c) Obtain the value after convolving the following part of the **integral** image at the integral value 670 (shaded with gray) with the given kernel. Clearly show the steps of calculation. [10]

15	30	90	180	300	450	605
15	50	150	300	460	660	855
45	120	265	480	670	905	1135
80	190	385	670	885	1140	1385
120	255	475	840	1075	1340	1596
180	375	630	1055	1305	1582	1847
230	470	760	1240	1500	1784	2057

Integral Image

2	2	2		-2	-2	-2
2	2	2		-2	-2	-2
2	2	2		-2	-2	-2
-2	-2	-2		2	2	2
-2	-2	-2		2	2	2
-2	-2	-2		2	2	2

Convolution Kernel

Calculation:

Value after the convolution: .....

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[25 marks]

Question 4

a) Draw the block diagram of the standard **Image Analysis Model.** [5]

b) Apply the zero-order hold method to zoom the following 3x3 image. State clearly any convolution mask that you have used. [10]

12	10	14
8	24	12
4	8	10

Original Image

.....

Convolution Mask

.....

Zoomed Image

c) Obtain all the connectivity types between the shaded pixels in the following image. [10]

A	1	0	0	0	0	1	1	1 C
	0	1	0	0	0	1	1	0
	0	0	1	0	0	1	0	0
	0	0	1	1	1	1	0	0
	0	1	1	0	0	1	0	0
	0	1	0	0	0	1	1	0
	1	1	0	0	0	0	1	0
B	1	0	0	0	0	0	1	1 D

AB

:.....

AD

:.....

AC

:.....

BC

:.....

BD

:.....