



COMSATS University Islamabad, Lahore Campus
Department of Electrical and Computer Engineering

Terminal Examination – FALL 2020

Course Title:	Digital Image Processing	Course Code:	CPE415	Credit Hours:	4(3,1)
Course	Dr. Ikramullah Khosa	Program Name:	BS Computer Engineering		
Semester:	7 th	Batch:	FA17-BCE	Section:	A/B
Date:	15-01-2021				
Time Allowed:	3 Hours		Maximum Marks:	50	
Student's Name:			Reg. No.		

Important Instructions / Guidelines:

- This is a closed-book, closed-notes examination.
- The paper time is 3 Hr. You will have 15 min extra to upload the solution file on CUonline.
- Maximum file size limit is 15 MB. If your file is larger than 15 MB, upload it in two files.

Question 1 (CLO-1/PLO-1)

(07 Marks)

The probabilities of individual gray levels for a 3-bit coded image are given in the following table. Apply histogram equalization and compute the new pixel intensities after equalization. Show the original and equalized histograms, as well as the transformation function.

r_k	$P_r(r_k) = n_k/MN$
$r_0 = 0$	0.24
$r_1 = 1$	0.3
$r_2 = 2$	0.26
$r_3 = 3$	0.17
$r_4 = 4$	0.014
$r_5 = 5$	0.007
$r_6 = 6$	0.003
$r_7 = 7$	0.0015

Question 2 (CLO-1/PLO-1)

(07 Marks)

Define three color models and describe their use. Show the triangular/circular model for HSI and label it both with RGB and HSI components.

Question 3 (CLO-2/PLO-2)

(07 Marks)

Show that the Sobel and Prewitt masks give isotropic results only for horizontal and vertical edges, and for edges oriented at $\pm 45^\circ$ respectively.

Question 4 (CLO-2/PLO-2)

(07 Marks)

The Laplacian of Gaussian (LoG) can be obtained by difference of two Gaussians.

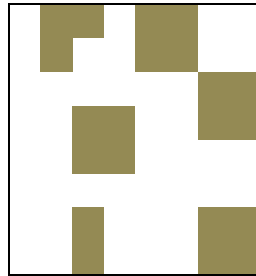
$$DoG(x, y) = \frac{1}{2\pi\sigma_1^2} e^{-\frac{x^2+y^2}{2\sigma_1^2}} - \frac{1}{2\pi\sigma_2^2} e^{-\frac{x^2+y^2}{2\sigma_2^2}}$$

prove that:

$$\sigma^2 = \frac{\sigma_1^2 \sigma_2^2}{\sigma_1^2 - \sigma_2^2} \ln \left[\frac{\sigma_1^2}{\sigma_2^2} \right]$$

Question 5 (CLO-2/PLO-2)**(07 Marks)**

Analyze the following image and break down into segments using split and merge procedure (employing Quad Tree method). Show the final quad tree after the segmentation process has finished.

**Question 6 (CLO-2/PLO-2)****(07 Marks)**

Analyze the following subset of an image and compute the two Gray Level Co-occurrence Matrices (GLCMs). To identify the size of the matrix, consider the pixel intensity range of the image. The position operators to calculate two GLCMs are:

- 1) $[1 \ 180^\circ]$
- 2) $[1 \ 45^\circ]$

2	1	2
4	1	2
1	5	4
5	4	5
2	3	1

Question 7 (CLO-2/PLO-2)**(08 Marks)**

Analyze the following polygonal shape and outline the following:

- 1) Chain Code (8-directional) with the order of 12 (i.e. 12 segments).
- 2) Difference
- 3) Shape number
- 4) Signature



End of paper