DEPARTMENT OF COMPUTER ENGINEERING
FACULTY OF ENGINEERING, UNIVERSITY OF BENIN, BENIN CITY, NIGERIA
B.ENG. EXAMINATION
CPE544: DIGITAL IMAGE PROCESSING
SESSION: 2018/2019 SECOND SEMESTER DATE: 06/12/2019 TIME: 2HRS
INSTRUCTION: Answer four (4) questions only.

---

1. (a) Explain the basic steps in digital image processing? (10marks)
   (b) Give three (3) examples on applications of digital image processing (3marks)
   (c) What is colour space? (3marks)
   (d) Compute the HSI value of the pixel in row 3 column 3 from the given RGB image "I" (9marks)

$$I = \begin{bmatrix} 100,100,100 & 150,0,0 & 0,150,0 \\ 255,0,0 & 255,255,255 & 0,0,0 \\ 100,150,200 & 0,0,255 & 100,200,150 \end{bmatrix}$$

2. (a) Describe and illustrate with a sketch the components of an image processing system (10marks)
   (b) What is principal component analysis (PCA)? (3marks)
   (c) List the steps on how to perform PCA (6marks)
   (d) Discuss the difference between "raster" and "vector" graphics and state two types of each formats (6marks)

3. (a) What is morphology in digital image processing? (3marks)
   (b) Describe and illustrate with sketches the following morphological operations (i) Dilation (ii) Erosion (iii) Opening (iv) Closing. (12marks)
   (c) Suppose an image is represented as "I" with a structuring element "S", compute (i) Dilation (ii) Erosion (iii) Opening (iv) Closing of the image "I". Use zero-padding to extend the image before computation. (10marks)

$$I = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}, \quad S = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

4. (a) What is segmentation? (3marks)
   (b) Show the segmentation of the matrix "I" below, given "M" as the mask and the threshold for computation is 50% of the total absolute pixel value of the matrix "I".

$$I = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 18 & 12 & 0 \\ 0 & 20 & 14 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}, \qquad M = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

(9marks)

(c) Describe and illustrate with sketches two types of pixels connectivity (8marks)

(d) Find the area and perimeter of the binary image "I", and state the pixel connectivity used for computation

$$I = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

(5marks)

5. Apply the following image enhancement techniques to the given matrix "M" (i) Histogram equalization with a scale of 20 (ii) Contrast stretching, considering "M" as a 3-bit grey level image (iii) Median filtering, using a mask of 3x3 (25marks)

$$M = \begin{bmatrix} 2 & 1 & 2 & 1 \\ 4 & 5 & 5 & 6 \\ 3 & 2 & 4 & 2 \\ 6 & 2 & 1 & 6 \end{bmatrix}$$

6. (a) What is feature extraction? Discuss the use of Gray Level Co-occurrence Matrix for feature extraction (11marks)

(b) Explain the following terms; supervised and unsupervised learning. State two (2) learning algorithm that are supervised and unsupervised. (8marks)

(c) Discuss the use of training-set and test-set for classification. (6marks)