DIGITAL IMAGE PROCESSING & PATTERN RECOGNITION
(ECE3121)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Name the procedure in which individual pixel values of the digital image get altered.
(a) Neighbourhood Operations (b) Image Registration
(c) Geometric Spatial Transformation (d) Single Pixel Operation

(ii) In neighbourhood operations working is being done with the value of image pixel in the neighbourhood and the corresponding value of a sub image that has same dimension as neighbourhood. The sub image is referred as
(a) Filter (b) Mask
(c) Template (d) All of the mentioned

(iii) Which of the following filter(s) attenuates low frequency while passing high frequencies of an image?
(a) Unsharp mask filter (b) Highpass filter
(c) Zero-phase-shift filter (d) All of the mentioned

(iv) Dilation followed by erosion is called
(a) Opening (b) Closing
(c) Blurring (d) Translation

(v) Two main operations of morphology are
(a) Erosion (b) Dilation
(c) Set theory (d) Both a and b

(vi) Structuring elements have origins at
(a) Top left (b) Top right
(c) Centre (d) Bottom left

(vii) The problem of finding hidden structure in unlabelled data is called
(a) supervised learning (b) unsupervised learning
(c) reinforcement learning (d) none of the above

(viii) Machine Learning is a field of Artificial Intelligence consisting of learning algorithms that?
(a) Improve their performance (b) At executing some task
(c) Over time with experience (d) All of the above

(ix) Which of the following statements is not true about k Nearest Neighbor?
(a) It belongs to the supervised learning domain
(b) It has an application in data mining and intrusion detection
(c) It is Non-parametric
(d) It is not an instance based learning algorithm

(x) The full form of PAC is _____
(a) Partly Approximation Computation (b) Probability Approximation Curve
(c) Probably Approximately Correct (d) Partly Approximately Correct

Fill in the blanks with the correct word

(xi) In K mean algorithm K stand for _____.

(xii) Identify whether true or false: In PCA the number of input dimensions is equal to principal components_____

(xiii) _____ determines the quality of a digital image

(xiv) Approaches to image processing that work directly on the pixels of incoming image work in _____

(xv) Region of Interest (ROI) operations is generally known as _____

Group - B

2. (a) How the digital image are formed? Explain the role of sampling and quantization in digital image processing. *[(CO1)(Analyse/L0CQ)]*
(b) Explain Euclidian, D4, D8 and DN distances in digital image processing. *[(CO2)(Understand/IOCQ)]*
(c) Find out Euclidian, D4 and D8 distance between two points P (0,0) and Q(4,1). *[(CO2)(Apply/IOCQ)]*

4 + 4 + 4 = 12

3. (a) Explain the role of image histogram and histogram equalization in digital image processing. *[(CO2)(Remember/LOCQ)]*
(b) Find the histogram of the given image in A.
A: [1 3 1 2; 2 1 4 3; 2 3 4 7; 6 1 2 1]. *[(CO3) (Apply/IOCQ)]*
(c) Perform the histogram equalization for the given image in B. show the output image.
B: [1 0 1 2; 2 1 4 3; 1 3 4 6; 6 1 1 1]. *[(CO3) (Apply/HOCQ)]*

3 + 3 + 6 = 12

Group - C

4. (a) Explain the role of morphological operations in digital image processing. Mention few applications of morphological operations. *[(CO3)(Remember/ILOCQ)]*

(b) What is erosion? What is structuring element? Explain the role of Structuring Element to perform Erosion operation. *[(CO3)(Remember/ILOCQ)]*

(c) Perform the erosion operation on an image of size 3X3. Consider a black and white image with suitable pixel values. You can take any type of structuring element. *[(CO3) (Apply/HOCQ)]*

3 + 3 + 6 = 12

5. (a) Explain the role of image compression in digital image processing. Draw a simple image compression model. *[(CO1)(Remember/LOCQ)]*

(b) Define the following terms regarding image compression: (i) Compression Ratio (ii) Saving percentage and (iii) Bit rate. *[(CO3)(Remember/LOCQ)]*

(c) An original image of size 256×256 pixels (gray scale i.e 8 bit /pixels) of file size 65536 bytes (64K) is compressed to a file size of 6554. Find the Compression Ratio , Saving Percentage and Bit Rate. *[(CO4)(Remember/LOCQ)]*

4 + 4 + 4 = 12

Group - D

6. (a) Illustrate the semi–supervised learning method. *[(CO5) (Remember/LOCQ)]*

(b) What are Decision Trees? Explain the structure of Decision Tree. *[(CO5) (Remember/LOCQ, Analysis /IOCQ)]*

(c) Is Naive Bias a classification algorithm or regression algorithm? State some benefits of Naive Bias algorithm. *[(CO5) (Analysis /IOCQ)]*

4 + (2 + 4) + 2 = 12

7. (a) Define Independent Component Analysis (ICA). How does it differ from Principal Component Analysis (PCA). *[(CO5)(Analyse/IOCQ)]*

(b) Discuss the limitations of ICA. What are some common issues one might face while applying ICA to real-world data? *[(CO5)(Create /HOCQ)]*

(2 + 3) + (4 + 3) = 12

Group - E

8. (a) What is covariance matrix? Explain the importance of covariance matrix in PCA. *[(CO7)(Remember/LOCQ)]*

(b) What do you mean by data mean of data set? Explain the process to determine the data mean of a given data set. *[(CO6)(Remember/LOCQ)]*

(c) Find the covariance matrix for the given data set:
X={2.5, 0.5, 2.2} and Y={2.4, 0.7, 2.9}. *[(CO3)(Analyse /IOCQ)]*

4 + 4 + 4 = 12

9. (a) What is SVM? Explain the working principle of as classifier. *[(CO5)(Analyse /IOCQ)]*

(b) how many types of SVM algorithms are there? What type of SVM will be used for linearly and non-linearly separable input dataset? *[(CO6)(Remember/LOCQ)]*

(c) Explain linear and non-linear SVM with example. *[(CO4)(Apply/IOCQ)]*

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	42.7	37.5	19.8