

**COMPUTER VISION
(CSEN 5233)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The smallest discernable change in intensity level is called _____
(a) color (b) saturation
(c) contrast (d) intensity resolution.
 - (ii) How many shades of grey are there in a 9-bit image?
(a) 511 (b) 256 (c) 512 (d) None of these.
 - (iii) Segmentation is a process that partitions image into
(a) blocks (b) regions (c) pixels (d) vertices.
 - (iv) Dilation-Morphological image operation technique is used to
(a) shrink brighter areas of the image
(b) diminishes intensity variation over the image
(c) expands brighter areas of the image
(d) scales pixel intensity uniformly.
 - (v) Sampling of an image is required for
(a) quantization (b) sharpening (c) smoothing (d) digitization.
 - (vi) Median filter is used to remove
(a) salt-and-pepper noise (b) speckle noise
(c) periodic noise (d) gaussian noise.
 - (vii) Which of the following is the disadvantage of using smoothing filter?
(a) Blur edges (b) Blur inner pixels
(c) Remove sharp transitions (d) Sharp edges.
 - (viii) The number of bits required to store a 256×256 image with 256 gray levels is
(a) 65536 (b) 327680
(c) 524288 (d) 2097152.

- (ix) Image restoration techniques are
(a) objective
(b) Subjective
(c) objective and based on mathematical or probabilistic model
(d) subjective and based on mathematical or probabilistic model.
- (x) To find edge in segmentation the following is used
(a) sobel operators (b) second order derivatives
(c) first order derivatives (d) all the above.

Group- B

2. (a) What is Hough Transform? Where can it be used? Use the algorithm for detecting a circle in polar form. [(CO1 & CO2)(Use/IOCQ)]
(b) Explain Sobel, Roberts and Prewitt operator for edge detection. [(CO2)(Understand/LOCQ)]
6 + 6 = 12
3. (a) Explain the following terms with respect to digital image capturing:
(i) Sampling, (ii) Quantization. [(CO1)(Remember/LOCQ)]
(b) Demonstrate image negative with suitable example. [(CO1)(Demonstrate/IOCQ)]
(c) What is the difference between 8-adjacency and m-adjacency? Compare using suitable example. [(CO2)(Compare/IOCQ)]
4 + 3 + 5 = 12

Group - C

4. (a) What is region splitting and merging in segmentation? [(CO3)(Remember/LOCQ)]
(b) How is thresholding used in segmentation? Explain along with diagrams. [(CO3)(Use/IOCQ)]
(c) Analyse the region growing technique for image segmentation? Do you see any problem associated with it? [(CO3)(Analyse/IOCQ)]
2 + 6 + 4 = 12
5. (a) What is Fourier Transform? [(CO3)(Remember/LOCQ)]
(b) What is its role in image processing? Prove that the unitary transform works for the given image.
 $F = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ and the given unitary transformation Kernel: $\frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ [(CO3)(Use/IOCQ)]
(c) Analyse how filtering is done in frequency domain. (Give all the steps from spatial domain to frequency domain and back) [(CO3)(Analyse/IOCQ)]
2 + 4 + 6 = 12

Group - D

6. (a) Define intensity histograms for a gray scale image. [(CO1)(Remember/LOCQ)]
 (b) Perform histogram equalization of the following image:
 [(CO1)(Construct/HOCQ)]
- | | | |
|---|---|---|
| 1 | 3 | 5 |
| 4 | 4 | 3 |
| 5 | 2 | 2 |
- (c) What do you mean by neighbours of a pixel? Define 4, 8 adjacencies of pixels in a grey scale image.
 [(CO1)(Understand/LOCQ)]
2 + 6 + 4 = 12
7. (a) Define Euclidean distance, city block distance and chess board distance with suitable examples.
 [(CO1)(Understand/LOCQ)]
 (b) Differentiate between image addition and subtraction with example. When are these operations used?
 [(CO3)(Differentiate/IOCQ)]
 (c) What is the significance of Spectral Range? How does an image with a narrow spectral range compare against an image with wide spectral range?
 [(CO3)(Compare/IOCQ)]
4 + 4 + 4 = 12

Group - E

8. (a) What problem does the Laplace smoothing technique solve in case of Naive Bayesian classification of documents? Mention the technique used and the rationale behind it. What benefit does the Bernoulli model add to the Naive Bayesian classification process?
 [(CO5)(Evaluate/HOCQ)]
 (b) Two land features TROPICAL and MOUNTAIN are found in some topographic sheets.
 There are lots of colours that are common in these sheets. So, it is difficult to identify a report referring to which type, TROPICAL or MOUNTAIN.
 However, analysts have created the following table for giving us hints as to what type the report could possibly refer to, based on some keywords. This is shown in the table below.

DocId	Keywords	Country?
1	Red, Green, Blue, Yellow	TROPICAL
2	Purple, Orange, Blue	TROPICAL
3	Green, Orange, Black	TROPICAL
4	Green,Red,Orange	MOUNTAIN

Now you have retrieved a report Doc5 where the following keywords are present:
 Green, Red, Purple, Blue
 You need to use MLE based estimation with NB classifier to find out whether the document belongs to TROPICAL or MOUNTAIN.
 (i) Find out the aprioriprobability of a document to belong to TROPICAL.
 (ii) Find out the conditional probabilities of the terms needed to classify Doc5.

(iii) Use NB classifier to find out whether the report refers to TROPICAL or not.

[(CO5)(Design/HOCQ)]

6 + 6 = 12

9. (a) Consider six points in 1-D space having the values 1,2,3,8,9,10, and 25. How would k-means partition the values, if we apply k-means using $k = 2$. Clearly show your construction of clusters and the final centroids. [(CO6)(Construct/HOCQ)]
- (b) Discuss the drawback faced by the above technique. [(CO4)(Evaluate/IOCQ)]
- (c) Now, construct the same clustering using k-medoids technique and show how it overcomes the above drawback. [(CO6)(Construct/HOCQ)]
- 5 + 3 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	25	46.88	28.12

Course Outcome (CO):

After the completion of the course students will be able to

C01.Learn basic concepts, terminology, theories, models and methods in the field of image analysis and computervision.

C02.Learn and understand shape and region analysis.

C03.Apply the vision technology in solving image processing and computer vision problems.

C04.Identify the limitations of vision systems.

C05.Develop skills to implement boundary detection and motion related techniques.

C06.Design successful applications to process and analyze images.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question