Time: Three Hours   Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	If the gray levels in an image range from 0 to 255, how many bits will be required to represent a pixel? What will be the size of a 100x100 image in bytes?	2	K2	CO1
2.	What do you understand by the term *salt-and-pepper* noise? What type of filter can be used for the removal of salt-and-pepper noise?	2	K3	CO1
3.	Canny edge detector has two thresholds – what are the purposes of these two thresholds?	2	K2	CO2
4.	How many components are there in the following image (size 5x5) if 4-adjacency connectivity is considered? Black pixels are object pixels.	2	K2	CO2

5.	What are the advantages of using Hough transform for the detection of straight edges in an image? What are the disadvantages of applying Hough transform?	2	K2	CO3

1

6.	Given an image of an circular arc, can we detect the centre of the circle? Justify your answer.	2	K3	CO3
7.	What is meant by camera calibration?	2	K1	CO4
8.	Define epipole of a camera with respect to another camera.	2	K2	CO4
9.	In a soccer match video, you wish to detect the presence of the football in a frame. Formulate a strategy.	2	K3	CO5
10.	What are the possible application areas of human gait analysis?	2	K3	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.	Questions	Marks	KL	CO
11. a)	We have an image with 3 bits per pixel. So the possible range of pixel intensity values is 0 to 7. The histogram of the image is given below.	13	K2	CO1

Gray value	0	1	2	3	4	5	6	7
Number of pixels	12	10	5	2	1	1	10	8

Find optimal threshold for binarization of the image using Otsu's method maximizing between class variance.

(OR)

b) i.	Apply Sobel operator filters on the following image and find the gradient magnitude and direction at the three shaded pixel positions.	8+5	K2	CO1

1	0	1	2	4
2	12	2	1	0
1	2	5	2	0
1	0	15	12	1
0	2	1	1	0

ii. What will be the result of applying median filtering to the image shown above (Q. 11. b. i). Consider that the size of the median filter is 3 x 3.

| 12. | a) | i. | Define 4-adjacency, 8-adjacency, and m-adjacency types of pixel-connectivity. | 6+7 | K2 | CO2 |
| | | ii. | Write a pseudocode to get the boundaries of the objects in a binary image. Show input and output with simple examples. The boundary edge reported using your method should follow 8-adjacency connectivity. | | | |

<div align="center">(OR)</div>

| | b) | i. | What is *skeletonization* of 2D shapes? What is the use of *skeletonization in computer vision?* | 5+8 | K2 | CO2 |
| | | ii. | Write an algorithm to find the number of connected components in a binary image. | | | |

| 13. | a) | | Write the Hough transform based algorithm for line detection. | 8+5 | K3 | CO3 |

Show the working philosophy of the proposed algorithm to find the best fitting line for the points (4,4), (3,3), (2,2), (-1,-1), (-2,-2), and (3, -3) in the image space.

<div align="center">(OR)</div>

| | b) | i. | Mention any two problems or applications where straight edge detection can be used as a solution technique. Write briefly about the solutions you are proposing (for each of the mentioned problems) involving detection of straight edges. | 5+8 | K3 | CO3 |
| | | ii. | Discuss how the Hough transform can be used to detect the presence of circles or circular objects or objects with circular arcs in an image? | | | |

| 14. | a) | i. | Explain projections and types of projections in 3D vision. | 5+8 | K3 | CO4 |
| | | ii. | What is optical flow? Discuss on optical flow method used in motion analysis. | | | |

<div align="center">(OR)</div>

| | b) | i. | Explain intrinsic and extrinsic parameters related to camera. Also state the usefulness for these parameters in the field of computer vision. | 5+8 | K3 | CO4 |
| | | ii. | Write about various applications of motion tracking (at least six applications) clearly identifying the problems. | | | |

| 15. | a) | i. | Why face detection is needed? Write briefly about various face detection methods. | 10+3 | K3 | CO5 |
| | | ii. | Is face recognition different from face detection? Explain. | | | |

<div align="center">(OR)</div>

b) i. What is foreground-background separation? Write briefly about some applications where foreground-background separation is necessary?   5+8   K3   CO5

     ii. Discuss *Chamfer matching* technique and why is it used? Explain in detail.

PART – C

(1 x 15 = 15 Marks)

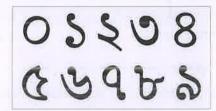| Q.No.		Questions	Marks	KL	CO

16. a) Consider the Bengali-numerals as shown below. The first row contains 0, 1, 2, 3 and 4; the second row contains 5, 6, 7, 8 and 9. Propose a set of visual features (at least ten features) capable of differentiating between the shapes (the numerals).   10 + 5   K3   CO3

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৫ ৬ ৭ ৮ ৯

Are the features rotation and scale invariant? Comment for each of them.

(OR)

b) In a parts-sorting problem, three classes are there and the objects need to be classified accordingly. The three classes are as given below: 10+2+3   K3   CO3

Class 1: Square washers with round centered holes;

Class 2: Round washers with square-centered holes;

Class 3: Round discs.

List / write adequate features to differentiate between the objects from these three classes. Comment on the robustness of your listed features.

Are the features rotation and scaling invariant? Comment on it.

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