Roll Number: _____

Thapar Institute of Engineering and Technology (TIET), Patiala
Department of Computer Science & Engineering (CSED)
MID SEMESTER EXAMINATION

B. E. (Third Year): Semester-V (2024-25) (COE/CSE)	Course Code: UCS532 Course Name: Computer Vision
September 25, 2024	Monday, 03:00 – 05:00 PM
Time: 02.00 Hrs, Max. Marks: 40, Weighed: 30 Marks	Name of Faculty: Dr. Shailendra Tiwari

Note: Attempt all questions in sequence. Assume suitable values for missing data.

S.No.	Questions	Marks	CO	BLT
Q. 1	(a) Why is computer vision important, and what factors (at least two) make it difficult? (b) Briefly describe a situation where the aliasing problem can occur and how this problem can be overcome. (c) Why median Filter is better than mean filter. Justify your answer with suitable example. (d) Explain the significance of scale invariance and rotation invariance in the context of SIFT and how they are achieved.	[2] [2] [2] [2]	CO1	2 1 2 1
Q. 2	(a) Perform the histogram equalization for 8 × 8 image shown below. (b) If the intensity value of a pixel in the 8-bit image is 200, what will be its intensity in the 4-bit quantized image? (c) Obtain the digital negative of the following 8 - bit sub image. (d) Find the gradient of the point $f(1,-2,-1)$ for $f(x,y,z) = 3x^2y - y^3z^2$?	[3] [1] [1] [1]	CO1	3 3 3 4
Q. 3	Given the following 5x5 grayscale image intensity matrix I, calculate the edge gradients using the Canny Edge Detector up to the non-maximum suppression step: (a) Use the Sobel operator to compute the gradients in the $x-direction\ G_x$ & $y-direction\ G_y$ over the given matrix I_{smooth} with zero padding. (c) Calculate the gradient magnitude and direction at the pixel located at (2,2) (centre pixel). (d) Describe the process of non-maximum suppression and indicate if the centre pixel will be retained as an edge pixel.	[4] [2] [4]	CO2	3 3 4
Q. 4	Consider that you have a keypoint detected at location $(x,y) = (5,5)$ in a 10×10 grayscale image. The local gradient magnitudes M and orientations θ in a 3×3 window around this keypoint is given as: (a) Compute the dominant orientation of the keypoint by creating an orientation histogram with 8 bins (each covering 45°). Assign the gradient magnitudes to the respective bins and determine the bin with the highest sum.	[4]	CO2	4

$I_{smooth} = \begin{bmatrix} 100 & 100 & 100 \\ 150 & 150 & 150 \\ 200 & 200 & 200 \end{bmatrix}$ $G_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$, $G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$

$M = \begin{bmatrix} 5 & 10 & 5 \\ 10 & 50 & 20 \\ 5 & 20 & 10 \end{bmatrix}$ $\theta = \begin{bmatrix} 0° & 45° & 90° \\ 180° & 90° & 135° \\ 270° & 225° & 315° \end{bmatrix}$

Gray Levels	0	1	2	3	4	5	6	7
No. of pixels	9	8	11	4	10	15	4	3

139	205	105
141	252	99
201	15	76

	(b) Identify the dominant orientation for this keypoint from the orientation histogram, how will the SIFT descriptor be aligned for this keypoint?	[2]		5