MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION
NOV/DEC 2023
SUBJECT: MOTION AND GEOMETRY BASED METHODS IN COMPUTER VISION (ECE 4078)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

Q. No.	Questions	M*	C*	A*	B*
1A.	Compute the two-level 2D Haar wavelet transform of the given image. $I = \begin{bmatrix} 10 & 21 & 12 & 23 \\ 20 & 10 & 21 & 12 \\ 31 & 22 & 13 & 20 \\ 22 & 13 & 21 & 10 \end{bmatrix}$	5	2	1,2	3
1B.	Compare the affine weak perspective projection model with pinhole camera projection model, with the help of neat diagrams.	3	6	2,3	4
1C.	Given a point in the camera coordinate system (Xc,Yc,Zc) =(1,1,1), and given the focal length =1, pixel size along both coordinates =0.5 and principle point at (2,2), compute the intrinsic camera calibration matrix and the corresponding image point coordinates.	2	1	1	3
2A.	Consider the dataset given below. Use Principal Component Analysis to reduce the dimensions of features to 1. Plot the principal component and the transformed features in the original feature space. **Feature** / **Data 1** / **Data 2** / **Data 3** / **Data 4** X / 4 / 8 / 13 / 7 Y / 11 / 4 / 5 / 14	5	3	2,3	3
2B.	Determine the pixel intensities in the transformed image after upscaling the given image, *I*, by a factor of 2. Use Bilinear interpolation. $I = \begin{bmatrix} 20 & 40 \\ 40 & 20 \end{bmatrix}$	3	3	2,3	3
2C.	Compute the short run emphasis and long run emphasis of the Run Length matrix used to detect the vertical features in the given image. $I = \begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 3 & 1 & 0 \\ 0 & 1 & 2 & 3 \\ 0 & 0 & 1 & 2 \end{bmatrix}$	2	2	1,2	3

3A.	Describe the procedure of KLT algorithm for object tracking. Evaluate its limitations, and suggest a solution with proper reasoning.	5	4	1,2	4
3B.	Discuss the Horn and Schunk algorithm for object tracking. At time t_0=0, a point object is located at real world coordinates (20,40,10), and is moving with constant speed =(-4,-8,-2), towards the observer. Assuming unit focal distance of the optical flow system, a.Determine the location of object at image coordinates at time t_0. b.Determine the image coordinates of the Focus of Expansion.	3	4	3	3
3C.	Determine the vector cosine of the line passing through the points (2,4,6) and (3,1,-5).	2	5	3	3
4A.	Compare and contrast the local and global binocular fusion methods for point-pair correspondence estimation. Explain the need for image rectification.	5	5	2,3	4
4B.	Explain in detail the stratified method for 2D metric reconstruction.	3	5	1	2
4C.	Determine the vector equation of plane passing through the points (1,1,-1), (6,4,-5), and (-4,-2,3).	2	5	3	3
5A.	Discuss the Affine structure from motion using affine epipolar geometry, with the help of a neat diagram.	5	6	1	2
5B.	An affine matrix represents a rotation of 45 degrees about the origin and a horizontal shear by a factor of 0.25. Determine the affine matrix and calculate the new point coordinates for a given object with vertices at (0,0), (4,0) and (0,4). Plot the position of the object, before and after the transformation.	3	1	1	3
5C.	Given two cameras, compute the minimum number of point correspondences required to reconstruct Perspective structure from motion.	2	6	3	3

M*--Marks, C*--CLO, A*--AHEP LO, B* Blooms Taxonomy Level