

Branch Name:	M.Sc. (Artificial Intelligence & Data Science)
Program Code:	ET214
Course Title:	Computer Vision
Course Code:	1ET2140202
Pre-requisite Course:	Machine Learning, Linear Algebra, Digital Image Processing

Course Objectives:

1. To understand fundamentals of human visual perception and computer vision systems.
2. To analyze image formation models, camera geometry, and multi-view vision.
3. To apply image processing and feature extraction techniques for vision-based tasks.
4. To explore motion estimation, stereo vision, and structure-from-motion concepts.
5. To design computer vision solutions for real-world applications such as recognition, tracking, and surveillance.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	00	02	04	50	50	25	25	150

Course Contents:

Unit No	Topic	Total Hours	Weightage (%)
1	Introduction to Human Vision and Computer Vision: Human eye and brain vision process, low, intermediate and high-level vision, overview of computer vision applications such as biometrics, object recognition, tracking, medical imaging, multimedia, AR/VR	08	15%
2	Image Formation Models and Geometry: Monocular imaging system, radiometry (radiance, irradiance, BRDF), camera models, orthographic and perspective projection, camera calibration, binocular vision, multiple view geometry, depth estimation, photometric stereo, shape from shading	10	20%
3	Image Processing and Feature Extraction: Image pre-processing, image representations, filtering, edge detection, feature descriptors (SIFT, SURF, ORB), keypoint detection and matching	08	20%
4	Motion Estimation and 3D Vision: Optical flow, stereo vision, motion estimation, structure from motion, depth estimation, multi-view reconstruction	04	10%
5	Shape Representation and Image Segmentation: Contour and region-based segmentation, active contours (snakes), level set methods, Fourier and wavelet descriptors, multiresolution analysis	08	20%
6	Applications of Computer Vision: Face detection and recognition, object tracking, surveillance analytics, background subtraction, human gait analysis, intelligent transportation vision systems, multi-camera view fusion	04	15%

Text Books:

1. Richard Szeliski – *Computer Vision: Algorithms and Applications*, Springer.
2. Gonzalez & Woods – *Digital Image Processing*, Pearson.
3. Forsyth & Ponce – *Computer Vision: A Modern Approach*, Pearson.

Reference Books:

1. Simon J. D. Prince – *Computer Vision: Models, Learning, and Inference*, Cambridge University Press.
2. Milan Sonka – *Image Processing, Analysis and Machine Vision*, Cengage.
3. OpenCV Documentation – Official Library Reference.
4. David Marr – *Vision*, MIT Press.

LIST OF EXPERIMENTS / PRACTICALS

1. Implementation of basic image preprocessing techniques (grayscale conversion, filtering, normalization) using Python/OpenCV.
2. Edge detection using Sobel, Canny, and Laplacian operators.
3. Feature detection and matching using SIFT/SURF/ORB descriptors.
4. Camera calibration and perspective transformation using OpenCV.
5. Implementation of optical flow for motion estimation in video sequences.
6. Stereo vision and depth map estimation from stereo image pairs.
7. Image segmentation using thresholding, region growing, and watershed methods.
8. Face detection using Haar Cascade and deep learning-based models.
9. Object tracking using Kalman Filter or Mean Shift algorithm.
10. Background subtraction and foreground detection in surveillance videos.
11. Multi-view geometry demonstration and 3D reconstruction from images.
12. Mini Project: End-to-end computer vision application (face recognition, traffic sign detection, or medical image analysis).

Course Learning Outcomes (CLO):

CO	Statement	Bloom's Level
CO1	Understand fundamentals of human vision and computer vision systems	L2 – Understand
CO2	Apply image processing and feature extraction techniques for visual data analysis	L3 – Apply
CO3	Analyze motion estimation, depth perception, and multi-view vision algorithms	L4 – Analyze
CO4	Evaluate segmentation and object recognition methods for real-world vision tasks	L5 – Evaluate
CO5	Develop computer vision applications for recognition, tracking, and intelligent systems	L6 – Create

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H	M	–	–	M	–	–	–	–	L	–	M	H	M	H	L
CLO2	M	H	M	M	H	–	–	–	L	M	–	M	H	H	M	M
CLO3	M	H	H	H	H	–	–	–	L	M	–	M	H	H	H	M
CLO4	M	H	H	H	H	–	–	–	M	H	M	M	H	H	H	M
CLO5	M	H	H	H	H	M	L	M	M	H	H	H	H	H	H	H

H:High, M:Medium, L:Low