Course Code: CSBB 314	**Open course (YES/NO)**	**HM Course (Y/N)**	**DC (Y/N)**	**DE (Y/N)**
	No	No	Yes	No
Type of course	Core			
Course Title	**Computer Vision**			
Course Coordinator				
Course Objectives:	Provide students with advanced knowledge of Computer Vision, Image Processing, Machine Learning and Deep Learning, enabling them to design, implement, and apply various models.			
Course Outcomes	**CO1:** Understand foundational concepts of deep learning, including neural networks, training methods, and optimization techniques.			**L1, L2, L3**
	CO2: Develop and evaluate convolutional neural networks (CNNs) for image classification and object detection.			**L4, L5, L6**
	CO3: Design recurrent neural networks (RNNs) and Transformer models for NLP and time-series analysis.			**L4, L5, L6**
	CO4: Implement advanced deep learning techniques for generative modeling, speech recognition, and gesture recognition.			**L4, L5, L6**

Semester	**Autumn: No**		**Spring: Yes**		
V	**Lecture**	**Tutorial**	**Practical**	**Credits**	**Total teaching hours**
Contact Hours	3	0	2	4	60
Prerequisite course code as per proposed course numbers	Machine Learning Course				
Prerequisite credits					
Equivalent course codes as per proposed course and old course					
Overlap course codes as per proposed course numbers					

Text Books:

1.	Title	Computer Vision: Algorithms and Applications
	Author	Richard Szeliski
	Publisher	Springer

	Edition	2016
Reference Book:		
1.	Title	Computer Vision: a Modern Approach
	Author	David Forsyth and Jean Ponce
	Publisher	Pearson
	Edition	2015
2.	Title	Multiple View Geometry in Computer Vision
	Author	Richard Hartley and Andrew Zisserman
	Publisher	Cambridge University Press
	Edition	2014

Content	**Unit 1** **Introduction to computer vision** Overview of Computer Vision, Applications of Computer Vision in Robotics, Healthcare, and Autonomous Vehicles, Basic Image Formation and Representation, Image Filtering: Smoothing, Sharpening, and Histogram Equalization. **Unit II** **Image Processing and Feature Detection Fundamentals** Grayscale and Color Image Processing, Image Transformations: Fourier Transform, Discrete Cosine Transform (DCT), Edge Detection: Sobel, Canny, and Laplacian, Corner and Blob Detection (Harris Corner Detector, FAST, SIFT, and SURF), Image Matching and Transformation: Homography and RANSAC, Keypoint Descriptors **Unit III** **Machine Learning for Computer Vision Tasks** Classification: SVMs, KNN, Decision Trees, Introduction to Neural Networks and Convolutional Neural Networks (CNNs), Deep Learning Architectures for Vision (AlexNet, ResNet, VGG), Anomaly Detection in Images (e.g., Autoencoders), Applications: Face Recognition, Gesture Recognition, and Scene Understanding **Unit IV** **Convention computer vision and algorithms** Object detection and segmentation e.g. Edge, texture, region, detection of sliding windows: Feature extraction, e.g. linear binary pattern, principal component analysis, Gabor filters, bags of features, Matching and recognition e.g. Bayesian classifier, support vector machine, fusion, Image alignment and stitching. Principal Component Analysis (PCA) **Unit V** **Deep learning and Neural Networks for computer vision** Key components and basic architecture of deep neural network, Convolution neural network, Object detection using R-CNN, Segmentation using image-to image neural network, Temporal processing and recurrent neural network.

List of Experiments	1. To implement data visualization techniques such as box plot, scatter plot, and Q plot for comprehensive analysis of a given dataset. 2. To apply Gaussian, Median, and Bilateral filters to reduce noise in images while preserving important structural details. 3. To enhance and detect edges in images by applying Sobel, Prewitt, and Laplacian filters, emphasizing significant transitions in pixel intensity. 4. To classify images using a Support Vector Machine (SVM) model and assess performance through cross-validation and key metrics such as accuracy and confusion matrix. 5. To apply Convolutional Neural Networks (CNNs) for image classification and evaluate the model's performance using standard metrics such as accuracy and confusion matrix. 6. To implement K-Nearest Neighbors (KNN) for image classification and evaluate its effectiveness through cross-validation and performance metrics such as accuracy. 7. To apply the Fast Fourier Transform (FFT) to convert images into the frequency domain and filter out high-frequency noise, enhancing image quality. 8. To apply Principal Component Analysis (PCA) for reducing the dimensionality of image datasets while retaining the most significant features. 9. To extract texture features from images using Gabor filters, enhancing the understanding of surface patterns and texture-related information. 10. To perform object detection by leveraging Region-based Convolutional Neural Networks (R-CNN) for detecting and classifying objects in images. 11. To implement Long Short-Term Memory (LSTM) networks for sequential image classification and evaluate the model’s performance using cross-validation and accuracy metrics. 12. To classify images using a Decision Tree model and evaluate its performance using cross-validation and metrics such as accuracy, precision, and recall.
Course Assessment	Continuous Evaluation 25%
	Mid Semester 25%
	End Semester 50%