Course Type	Course Code	Name of Course	L	T	P	Credit
SDC (Minor)	**NCSM302**	**DATA PRESENTATION AND VISUALISATION TECHNIQUES LABORATORY**	0	0	3	1.5

Course Objective

Practical Implementation of different problems of digital image processing, computer vision, machine learning, and deep learning with the aim of providing better practical and research understanding in these domains.

Learning Outcomes

Enhance the practical ability to understand different parts of digital image processing, computer vision, machine learning, and deep learning and also to provide better understanding about their uses in real world applications.

Unit No.	Topics to be Covered	Practical Hours	Learning Outcome
1	Image Enhancement: Histogram Processing, Spatial Domain Filtering, Edge Sharpening, Frequency Domain Lowpass and Highpass Filtering.	3	Implementation of different image enhancement techniques used in spatial and frequency domains.
2	Image Restoration: Image Restoration Filtering, Notch Filter, Image Estimation, Geometric Transformation.	3	Implementation of different image restoration techniques used in spatial and frequency domains.
3	Image Morphology: Fundamental Operations; Morphological Algorithms.	3	Implementation of different operations used in image morphology.
4	Image Segmentation: Adaptive Thresholding, Region-based Segmentation, Point, Line, and Edge detection, Canny Edge Detector, Hough Transform.	3	Implementation of different types of image segmentation methods and their use in real applications.
5	Image Compression: Lossless Compression (Shannon-Fano Coding, Huffman Coding, Arithmetic Coding), Lossy Compression (Block Truncation Compression).	3	Implementation of different lossless and lossy image compression techniques.
6	Camera Calibration: The Three-dimensional World, Invariants and Perspective, Image Transformations. Camera Calibration and Motion	3	Implementation of practical and realistic problems encountered by machine vision in real 3D world.
7	Applications of Computer Vision: Real Time Vision Systems, Face Detection and Recognition, Surveillance In-vehicle Vision Systems.	3	Implementation of complex systems with more practical problems in vision.
8	Python data representations, Numpy basic and visualization (Matplotlib). Scikit Learn dataset loading and visualization. Dimensionality reduction (t-SNE).	3	Data handling and data visualization.
9	Linear regression and logistic regression. Implementation of gradient descent using Numpy and closed form solution.	3	Implementation of linear and logistic regression and exposure to gradient descent.
10	Implementing Decision Trees. Applying different feature selection strategies. Pruning algorithms to address overfitting.	3	Implementation of decision trees and detection of overfitting in training process.
11	Implementing clustering algorithms: kNN, K-means, HAC.	3	Implementation of unsupervised learning techniques.
12	Implementation of a multi-layer feedforward neural network using PyTorch library for classification and regression tasks.	3	Implementation of multilayer perceptron with different loss and activation functions.

13	Implementation of a recurrent neural network using PyTorch library for language modelling.	3	Implementation of neural networks for sequence modelling.
14	Implementation of a convolutional neural network using PyTorch library on MNIST dataset.	3	Implementation of convolutional neural networks for computer vision.
			Total: 42

Text Books:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson Education.
2. R. Hartley and A. Zisserman, "Multiple View Geometry in Computer Vision", Cambridge University Press.
3. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly.
4. Eli Stevens, Luca Antiga, Thomas Viehmann, "Deep Learning with PyTorch: Build, train, and tune neural networks using Python tools", Manning.

Reference Books:

1. A. K. Jain, "Fundamentals of Digital Image Processing", Pearson India Education.
2. Nikhil Ketkar, Jojo Moolayil, "Deep Learning with Python: Learn Best Practices of Deep Learning Models with PyTorch", Apress.
3. Yuxi Liu, "Python Machine Learning By Example", Packt.