Course Type	Course Code	Name of the Course	L	T	P	Credits
DE	**NMCD416**	**DEEP LEARNING WITH COMPUTER VISION**	3	0	0	3

Course Objective

This course provides a comprehensive understanding of computer vision techniques combined with deep learning methods. Students will gain hands-on experience in implementing deep learning-based solutions for various computer vision tasks like image classification, object detection, segmentation, and more.

Learning Outcomes

Understand key computer vision concepts and techniques. Be proficient in building and training deep learning models for image-based tasks. Gain hands-on experience using modern models like CNNs, GANs, and Transformers in computer vision. Apply the learned techniques to solve real-world problems in domains such as autonomous driving, medical imaging, and surveillance.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Overview of computer vision and its applications (e.g., facial recognition, object tracking), Image processing basics: pixel representation, convolution, filtering, Edge detection, Sobel operator, Canny edge detector, Color spaces: RGB, HSV, Lab, etc., Introduction to deep learning for computer vision.	7	Understand the key challenges in computer vision, and how deep learning can be integrated to solve them.
2	Basics of neural networks: perceptrons, activation functions, backpropagation, Convolutional Neural Networks (CNNs) fundamentals: layers, kernel functions, pooling, Regularization techniques: dropout, batch normalization, Optimizers: Adam, SGD, and learning rate schedules. Building a simple CNN for image classification.	10	Learn to implement CNN architectures for image classification tasks, utilizing transfer learning and data augmentation.
3	Object detection algorithms: R-CNN, Fast R-CNN, YOLO (You Only Look Once), SSD (Single Shot Multibox Detector), Region Proposal Networks (RPN), Image segmentation: Fully Convolutional Networks (FCNs), U-Net, Semantic vs instance segmentation, Generative Adversarial Networks (GANs) for image synthesis and enhancement, Variants of GANs: DCGAN, StyleGAN.	10	Master advanced architectures for object detection, segmentation, and image synthesis.
4	Introduction to Transformer architectures and their relevance in computer vision, Vision Transformers (ViT): architecture and benefits over CNNs, Self-attention and multi-head attention in transformers, Implementation of ViT for image classification and segmentation, Comparing CNNs and Transformers in computer vision tasks.	8	Explore the latest developments in computer vision with transformers and self-attention mechanisms.
5	Applications in autonomous driving: image-based navigation, pedestrian detection, and road sign recognition, Medical imaging: automated diagnosis (e.g., using CNNs for tumor detection), Surveillance systems: face recognition and object tracking, Ethical considerations: fairness, bias, and privacy in computer vision, Case studies of commercial computer vision systems: Tesla, Google Photos, etc.	7	Understand real-world applications of computer vision and deep learning. Learn how to deal with ethical and deployment challenges.
	Total	**42**	

Textbook:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2022.

Reference Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
2. John D. Kelleher, Deep Learning, MIT Press, 2019.