

Subject Description Form

Subject Code	DSAI5209
Subject Title	Visual Data Representation and Processing
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	• Provide students with knowledge of the fundamentals of visual data representation, encoding, and compression techniques. • Provide students with knowledge of a wide spectrum of visual data protection and security techniques. • Train students to apply advanced AI techniques to visual data processing
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) Have a good understanding of visual data representation, encoding, and compression techniques. b) Have a deep understanding of the techniques and requirements for the protection of visual data. c) Critically review and consolidate the skills for problem solving involving visual data; and d) Conduct a real-world case study in processing visual data using advanced AI techniques.
Subject Synopsis/ Indicative Syllabus	1. Image and Video Representation Common visual data augmentation methods and representation formats, Sampling and Quantization, Visual Data Interpolation and Frame Resolution Enhancement Methods, Distortion Measurement, Rate-Distortion Theory 2. Color and Audio Representation Color and Audio Fundamentals, CMY and CMYK Color Models, RGB and HIS Representations, Color Models and Processing 3. Video Compression Fundamentals Lossless Predictive Coding, Lossy Visual Data Compression using Discrete Cosine Transform and Wavelet based Encoding, Color Models in Videos and Representation, Compression Techniques, Standards like JPEG, MPEG, etc. 4. Video Processing Block Based Motion Estimation, 2D Logarithmic search, Hierarchical search, video encoding standards, Forward and Bidirectional Prediction, Group of Frames, Transmission and Display Sequencing in Videos 5. Object Detection in Videos Bounding boxes, Performance metrics for Object detection like Intersection over Union, Precision, Recall, etc. Common object detection models like

	YOLO or SOLO, and foundation models like SAM or SE, Semantic Segmentation					
	6. Image and Video Content Protection Video Watermarking for Rights Protection and Monitoring, Spatial and Spectral Domain Techniques, Content Identification and Security.					
Teaching/Learning Methodology	The course material will be delivered as a combination of lectures, tutorials, and small group projects. Students will get familiar with basic concepts and technologies of visual data processing, representations and applications.					
Assessment Methods in Alignment with Intended Learning Outcomes	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
			a	b	c	d
	1. Assignments, Quizzes and Projects	55%	✓	✓	✓	✓
	2. Final Examination	45%	✓	✓	✓	✓
	Total	100 %				
	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: The examination and assignments are designed to evaluate the students’ understanding of visual data-related concepts and processing. The project, on the other hand, is designed to evaluate the students’ practical skills in using advanced AI methods and models for processing visual data for real-world problems.					
Student Study Effort Expected	Class contact:					
	▪ Lectures / Tutorials / Labs			39 Hrs.		
	Other student study effort:					
	▪ Assignment, Project, Quizzes, and Examination			66 Hrs.		
	Total student study effort			105 Hrs.		
Reading List and References	1. R. Shanmugamani, <i>Deep Learning for Computer Vision</i>, Packt Publishing, Jan 2018. 2. Zhang, Aston and Lipton, Zachary C. and Li, Mu and Smola, Alexander J., <i>Dive into Deep Learning</i>, arXiv preprint arXiv:2106.11342, 2021. 3. Mohamed Elgendy, <i>Deep Learning for Vision Systems</i>, October 2020. 4. A. Kumar, <i>Iris and Periocular Recognition using Deep Learning</i>, Academic Press, 2024. 5. Z.-N. Li, M.S. Drew, J. Liu, Fundamentals of Multimedia, Pearson, 2014 6. IEEE Transaction on Pattern Analysis and Machine Intelligence. 7. IEEE Transaction on Knowledge and Data Engineering.					