City University of Hong Kong
Course Syllabus

offered by Department of Electrical Engineering
with effect from Semester A in 2024/2025

Part I Course Overview

Course Title:	Topics in Computer Vision
Course Code:	EE5811
Course Duration:	One Semester (13 weeks)
Credit Units:	3
Level:	P5
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Mathematical knowledge reaching the equivalent of [MA3150 Advanced Mathematical Analysis, or MA3151 Advanced Engineering Mathematics] and [MA3160 Probability and Stochastic Processes, or EE3313 Applied Queueing Systems] and Programming knowledge reaching the equivalent of [CS2363 Computer Programming or equivalent] Specifically, C programming will be required.
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to provide students with an in-depth critical understanding of Computer Vision's principles, concepts, and advanced techniques. The main objective of this course is to develop students with the fundamental knowledge of how machines understand and process data in the visual world. The outline of this course includes the topics of computer vision from the perspectives of low-level image processing (e.g., image mathematical and physical modelling, image enhancement, image coding, and filtering, edge and contour detection, image statistics analysis) and high-level visual semantic understanding (e.g., image recognition, image segmentation, motion analysis), along with different real-world applications where computer vision techniques have been applied. This course will also provide students with the understanding of cutting-edge technologies, such as foundation model and out-of-distribution generalization.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Apply low-level computer vision techniques to analyze basic image/video properties.		✓	✓	
2.	Apply high-level computer vision algorithms for image/video understanding.		✓	✓	
3.	Apply machine learning algorithms for different computer vision problems.		✓		
4.	Apply and evaluate computer vision algorithms based on the popular software (e.g., Python, MATLAB) for real-world applications.		✓	✓	
		100%			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

(LTAs designed to facilitate students' achievement of the CILOs.)

LTA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4			
Lecture	Students will involve in the lectures to gain knowledge of the key concepts of image understanding and computer vision.	✓	✓	✓				2 hrs/wk
Tutorial/lab	Key concepts are worked out based on questions and problem solving Students will involve in the project assigned by instructors to improve their problem solving skills.	✓	✓	✓	✓			1hr/wk
Assignments	Through working on the assignments, students will learn how to use image processing and computer vision algorithms and related software tools (e.g., OpenCV) for solving computer vision problems	✓	✓	✓	✓			

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4				
Continuous Assessment: 50%								
Assignments (3)	✓	✓	✓	✓			20%	
Quizzes (2)	✓	✓	✓				30%	
Final Examination: 50% (duration: 2hrs)								
Examination	✓	✓	✓				50%	
							100%	

Remark:

To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Examination	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Significant	Moderate	Basic	Not even reaching marginal level

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B,)	Marginal (B-, C+, C)	Failure (F)
1. Examination	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level
2. Coursework	Achievements in CILOs	High	Medium	Low	Not even reaching marginal level

6. Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1	The student will acquire an ability to describe current and anticipated trends in computer vision and information engineering through an overview of the field as well as an in depth understanding of selected topics through lectures, tutorials and assignments
2	The student will be able to evaluate and analyze new technologies in computer vision through an understanding of the performance and limitations of current computer vision technology through lectures, tutorials and assignments.
3	The student will be able to apply specialist knowledge in the assignment of computer vision.
4	The student will be able to assess, evaluate and formulate solutions to problems or specifications in computer vision through theoretical and practical knowledge learnt during lectures, tutorials and assignments.

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Image Mathematical and Physical Modelling
Image/video acquisition and representation; image statistics analysis; convolution; Fourier transform and Wavelet transform; principle component analysis; camera calibration; optical aberration; reflection; single-view modelling; stereo.

Applicable for student admitted from Semester A 2024/2025 and thereafter

Image/Video Processing
Image degradation; image transformation; image sampling; image filtering; image enhancement and restoration; image/video coding.

Applicable for student admitted from Semester A 2020/2021 to Semester B 2022/2023

Image/Video Processing
Image degradation; image transformation; image sampling; image filtering; image enhancement and restoration; image/video coding

Feature Extraction
Interest point detection; edge detection; corner detection; line and curve detection; color and texture analysis.

Applicable for student admitted from Semester A 2024/2025 and thereafter

Visual Analysis and Understanding
Image segmentation; object recognition; scene understanding; motion analysis; optical flow; pattern recognition; machine learning; neural networks; deep learning. generative model.

Applicable for student admitted from Semester A 2020/2021 to Semester B 2022/2023

Visual Analysis and Understanding

Image segmentation; object recognition; scene understanding; motion analysis; optical flow; pattern recognition; machine learning; neural networks; deep learning, foundation model in computer vision and multiple modality (i.e., computer vision + natural language processing), out-of-distribution generalization in computer vision.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

	N/A

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	D. Forsyth and J. Ponce, Computer Vision: A Modern Approach, 2nd edition, Prentice Hall (2011)

2.	R. Gonzalez and R. Woods, Digital Image Processing, 3rd edition, Prentice Hall (2007)
3.	Computer Vision: Algorithms and Applications, 2nd edition, 2021
4	Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision (CENGAGE Learning, 4th edition, 2015)