

EE5811: TOPICS IN COMPUTER VISION

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Topics in Computer Vision

Subject Code

EE - Electrical Engineering

Course Number

5811

Academic Unit

Electrical Engineering (EE)

College/School

College of Engineering (EG)

Course Duration

One Semester

Credit Units

3

Level

P5, P6 - Postgraduate Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

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

Nil

Exclusive Courses

Nil

Part II Course Details

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.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Apply low-level computer vision techniques to analyze basic image/video properties.		x	x	
2	Apply high-level computer vision algorithms for image/video understanding.		x	x	
3	Apply machine learning algorithms for different computer vision problems.		x		
4	Apply and evaluate computer vision algorithms based on the popular software (e.g., Python MATLAB) for real-world applications.		x	x	

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.

Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lecture	Students will involve in the lectures to gain knowledge of the key concepts of image understanding and computer vision.	1, 2, 3	2 hrs/wk

2	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.	1, 2, 3, 4	1hr/wk
3	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	1, 2, 3, 4	

Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks ("- for nil entry)	Allow Use of GenAI?	
1	Assignments	1, 2, 3, 4	20	-	Yes
2	Quizzes (2)	1, 2, 3	30	-	No

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

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

Assessment Rubrics (AR)**Assessment Task**

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task

Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal level

Assessment Task

Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B) Medium

Marginal

(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Assessment Task

Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B) Medium

Marginal

(B-, C+, C) Low

Failure

(F) Not even reaching marginal level

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO 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

PILO 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.

PILO 3 - The student will be able to apply specialist knowledge in the assignment of computer vision.

PILO 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

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.

Reading List

Compulsory Readings

Title	
1	Nil

Additional Readings

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