The Hong Kong University of Science and Technology

UG Course Syllabus

Digital Image Processing

ELEC 3130

3 Credits

Pre-requisites: ELEC 2100

Co-requisites: ELEC 3100 OR ELEC 3200

Exclusion: COMP 4421, MATH 4336

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Course Description

This course introduces methods to process images on a computer. Topics include the formation and quantification of digital images, morphological image processing, image enhancement in the spatial and frequency domain, image restoration, color image processing, image compression, image segmentation, object recognition and face detection. Students are expected to obtain knowledge of digital image processing, machine learning algorithms, and hands-on experience in programming and presentation skills through the final project. This course is mathematics oriented. It requires basic knowledge of linear algebra, calculus and linear filtering. Familiarity with the programming language MATLAB is needed

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain the fundamental principles of digital image formation, sampling, quantization, and representation.
2. Apply mathematical transforms and filtering methods for image enhancement and restoration.
3. Analyze and implement morphological operations, segmentation algorithms, and feature extraction techniques.
4. Evaluate classical approaches for object recognition and face detection.
5. Design and implement image processing solutions using MATLAB or equivalent programming tools.
6. Demonstrate problem-solving, technical communication, and presentation skills through an image processing project.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Homework	20%	30/03/2027 *
Midterm	30%	15/04/2027 *
Final Project	50%	20/05/2027 *

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework	ILO1, ILO2, ILO3, ILO5	This task assesses students' ability to explain image representation concepts (ILO1), apply transforms and filtering methods (ILO2), implement morphological operations, feature extraction (ILO3), and develop working image processing programs (ILO5).
Midterm	ILO1, ILO2, ILO3	This written exam assesses students' ability to explain principles of digital image formation, sampling, and quantization (ILO1), apply transforms and filtering methods for enhancement and restoration (ILO2), analyze segmentation and feature extraction algorithms (ILO3).
Final Project	ILO2, ILO3, ILO4, ILO5, ILO6	The final project and presentation assess students' ability to apply image enhancement and restoration techniques (ILO2), analyze and implement segmentation and feature extraction algorithms (ILO3), evaluate recognition performance and system effectiveness (ILO4), design complete image processing solutions using MATLAB (ILO5), and demonstrate technical communication and presentation skills (ILO6).

Grading Rubrics

1. Accuracy of technical understanding
2. Analytical rigor
3. Application of methods
4. Programming / implementation quality
5. Clarity of presentation
6. Critical thinking and originality
7. Teamwork

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates comprehensive mastery of subject matter, strong analytical ability, and outstanding application skills
B	Good Performance	Shows solid understanding, competent analysis, and effective problem-solving ability.
C	Satisfactory Performance	Meets core learning outcomes with adequate understanding and acceptable performance.
D	Marginal Pass	Demonstrates minimum acceptable achievement of course learning outcomes.
F	Fail	Does not meet the minimum standards required to pass the course.

Course AI Policy

Students may use generative AI tools (e.g., coding assistants, writing support tools, or data analysis assistants) only when explicitly permitted for learning support. Any AI-assisted work submitted for assessment must be clearly acknowledged. Students remain fully responsible for the accuracy, originality, and integrity of submitted work. Unauthorized use of AI in graded assessments may constitute academic misconduct.

Communication and Feedback

Assessment marks for individual tasks will be communicated via Canvas within two weeks of submission. Feedback may include comments on technical strengths, conceptual understanding, coding quality, and areas for improvement. Students with questions regarding marks should consult the instructor within five working days after feedback release.

Resubmission Policy

Unless otherwise specified by the instructor, reassessment or resubmission is not permitted. Exceptional cases will be handled in accordance with university regulations.

Required Texts and Materials

Digital Image Processing

by Rafael C. Gonzalez and Richard E. Woods, Prentice Hall, 4 Edition, 2017.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources

References:

Digital Image Processing using Matlab
by Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins Prentice Hall, 2004.

Textbook webpage (a lot of online tutorials)

http://www.imageprocessingplace.com/

Tentative Syllabus

Week 1	Introduction
Week 2	Transforms
Week 3	Morphological Image Processing
Week 4	Image Enhancement in the Spatial Domain
Week 5	Image Enhancement in the Frequency Domain
Week 6	Image Restoration
Week 7	Motion Deblurring using Wiener Filter
Week 8	Color Image Processing
Week 9	Image Compression: JPEG as an Example
Week 10	Image Segmentation: Canny Edge Detector
Week 11	Object Recognition: Classical Approaches
Week 12	Face Recognition: Eigen Faces
Week 13	Final Review and Outlook: Deep Learning