Program: ECE
Degree Level: Master

Faculty/College: TGGS

Course 090245334

Digital Image Processing

King Mongkut's University of Technology North Bangkok

The Sirindhorn International Thai-German Graduate School of Engineering

Electrical and Computer Engineering Program

Section 1: General Information

1. Course code and course title

090245334 Digital Image Processing

2. Total credits

3 credits ☐ (2-2-5) ☑ (3-0-6) ☐ (3-0-9) ☐ (2-3-7)

3. Curriculum and course category:

Curriculum: *Master of Engineering in Electrical and Computer Engineering*

Course category: Required Courses

☐ Core Course ☐ Specific Core Course

☐ Industrial Internship ☐ Master Thesis

Elective Courses

☑ General Elective ☐ Specific Elective ☐ Other Elective

4. Course coordinator/ Instructors

Course Coordinator: Asst. Prof. Dr. Wannida Sae-Tang

Instructor(s): Asst. Prof. Dr. Wannida Sae-Tang

5. Semester/ year of study

☑ Semester 1 (Aug. to Dec.) ☐ Semester 2 (Jan. to May) Academic Year: 2023

6. Pre-requisite (if any)

☑ No ☐ Yes, please provide: .....

7. Co-requisites (if any)

☑ No ☐ Yes, please provide: .....

8. Venue of study

Lecture Day/Time: Tuesday at 13.00-16.00

☑ On-site: Lecture Room No.:....1101..... Floor:.....11.....

☑ TGGS, KMUTNB ☐ Faculty of Engineering, CU ☐ RWTH

☐ On-line*: Teaching Media: ☐ Microsoft Teams ☐ Google Meet ☐ Zoom ☐ Webex ☐ Other (specify) .....

Remark: * *During COVID-19, the teaching can be on-site and/or on-line according to TGGS Policy.*

9. Information for quality assurance in education

This course shows evidence of:

- ☐ Development of implementation from previous practices, e.g. the improvement of class teaching, course content, content classification and methods used for learning assessment
- ☐ Involvement from professional bodies/ external agencies in instruction; thus Enhancing student academic and professional experiences
- ☑ Integration of research or creative activities with instruction; use of research-based learning management; knowledge management practices for learning improvement
- ☐ Integration of academic services and course implementation
- ☐ Combination of cultural heritage preservation efforts into instruction or student activities

10. Date of latest revision:

July 2023

Section 2: Course Description and Implementation

1. Course Description (*As written in the Official Approved Curriculum*)

Fundamentals of digital image processing; color conversion; thresholding; image enhancement; noise reduction and image restoration; pixel sampling; image quantization; image filtering; edge detection; image watermarking; image encryption; image compression; image segmentation; morphological image processing; image registration; image recognition and classification; high dynamic range images.

2. Number of hours per semester

Lecture	Practice	Self-study
45 hours/ semester (*3 hours/week**)	*30 hours* (*2 hours/week**)	*75 hours/ semester* (*5 hours/week**)

Remark: * *Based on 15 weeks of lecture*

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Course Category:	☑ Lecture	☐ Practice	☐ Laboratory
Course Evaluation:	☑ A-F	☐ S/U	☐ P

3. Number of hours per week for academic guidance to individual students

☐ 1. Giving academic advice (minimally number hour per week) during the office hour

☐ 1 ☐ 2 ☑ 3 ☐ 4 ☐ 5 ☐ .....

Tuesday at 16.00-19.00

The student can arrange the time other than the office hour via telephone or email for the meeting date/time.

☐ 2. Adopting information technology-based academic advising

☐ Email: wannida.s@tggs.kmutnb.ac.th

☐ Phone: 086-986-0542

(Do not distribute this mobile number without permission.)

☐ Communication Apps: Line ID: wannida_kwan

(Please notify the lecturer when adding the line.)

☐ Meeting Online: The platform will be informed to students upon the request.

☐ Other (specify) .....

☐ 3. .....

4. Course Learning Outcomes (CLOs): Students should be able to:

CLO 1. Describe theoretical concepts of color conversion, thresholding, image enhancement, noise reduction and image restoration, pixel sampling, image quantization, image filtering, edge detection, image watermarking, image encryption, image compression, image segmentation, morphological image processing, image registration, image recognition and classification, high dynamic range images, and other knowledge in specific academic papers.

CLO 2. Write programs related to above topics.

CLO 3. Analyze performances of various image processing algorithms related to the above topics.

CLO 4. Create a new image processing algorithm for a specific problem.

Remark: 1. Guidelines according to Bloom's Taxonomy is available at https://courses.dcs.wisc.edu/design-teaching/PlanDesign_Fall2016/2-Online-Course-Design/2_Learning-Objectives-Alignment/6_objectives_blooms-taxonomy.html

2. For the master level course, CLOs should be "apply" and "analyze" or possibly to consider the doctoral CLOs "evaluate" and "create". "Remember" and "Understand" are for the undergraduate level courses, however, they can be implemented only at the beginning of the course.

3. CLOs can be defined as many as appropriated for the course.

5. The mapping between Expected Learning Outcomes (ELOs) from the curriculum and Course Learning Outcomes (CLOs)

Table 5.1 ELOs-CLOs Consistency *(for a subject-specific course/ a specific curriculum)*

ELOs/CLOs consistency	CLO 1	CLO 2	CLO 3	CLO 4
ELO1	✓			
ELO2			✓	
ELO3		✓		
ELO4				✓
ELO5				
ELO6				✓
ELO7				
ELO8	✓	✓	✓	✓
ELO9				

Remark: All ELOs and ELOs for the course (highlighted row) are as written in the Official Approved Curriculum.

Table 5.2 Mapping desirable characteristics of KMUTNB graduates and CLOs *(for non-specific courses designed for various curriculums)*

Consistency between desirable characteristics of KMUTNB Graduates - CLOs	CLO 1	CLO 2	CLO 3	CLO 4
1. **Professional credentials with critical thinking skills**			✓	✓
2. **Integrity and social responsibility**				
3. **Innovative and technopreneur mindset**				✓
4. **Global Competence**		✓	✓	✓

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Section 3: Student Improvement in relation to Course Learning Outcomes (CLOs)

Organizing learning to develop skills/ knowledge; evaluation of CLOs in accordance with the ones identified in Section 2.4

Course Learning Outcomes (CLOs)	Teaching Methods compliant with CLOs	Evaluation Methods compliant with CLOs
CLO 1	• Lecture* • Active learning** • In-class exercises • Individual assignments • Additional reading assignments from research and/or literature journals	• Assessment of individual assignments • Exam****
CLO 2	• Lecture* • Active learning** • In-class exercises • Individual assignments • Additional reading assignments from research and/or literature journals	• Assessment of individual assignments
CLO 3	• Lecture on how to analyze performances mathematically and numerically • Demonstration on coding for analyzing the performances • In-class exercises • Individual assignments • Additional reading assignments from research and/or literature journals	• Assessment of individual assignments • Exam****
CLO 4	• Project-based learning • Additional reading assignments from research and/or literature journals	• Project evaluation

*Remark: * Lecture on the concept of the topic is introduced with basic or fundamental definitions, visualization and correlations. For the complicated equation, the derivation from the basic laws can be shown to students. So, the students do not memorize the equations but understand the basic concept and basic equation. The lecturer will introduce the advanced*

and new concepts, technologies, and findings to students from publications such as journals and websites and from the research and industrial experiences.

** *Active learning by asking questions related to the topic in the lecture and encouraging the students to response to the questions. If the students cannot response with answers, then the lecturer will give some guidance until the students can respond.*

*** *Quiz in the closed-book format on the basic concepts and equations with simple problem solving to evaluate their learning. The solution will be given to students after grading, so they can identify their mistakes and weakness.*

**** *Exam on the basic concepts and equations with simple problem solving in the closed-book format as a review, whereas the complicated-integrated problem solving will be worked in the open-book format.*

Section 4: Lesson Plan and Evaluation

1. Lesson Plan

Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
1	Introduction to Digital Image Processing	CLO 1	3.0	• Lecture, Q&A/PowerPoint • Project Assignment	Asst. Prof. Dr. Wannida Sae-Tang
2	Digital Image Fundamentals	CLO 1 CLO 2 CLO 3	3.0	• Pre-Test • Lecture, Q&A/PowerPoint • In-Class Exercises/MATLAB Programming • Assignment No. 1	Asst. Prof. Dr. Wannida Sae-Tang
3	Color Conversion and Thresholding	CLO 1 CLO 2 CLO 3	3.0	• Pre-Test • Lecture, Q&A/PowerPoint • In-Class Exercises/MATLAB Programming • Assignment No. 2	Asst. Prof. Dr. Wannida Sae-Tang
4	Image Enhancement	CLO 1 CLO 2 CLO 3	3.0	• Pre-Test • Lecture, Q&A/PowerPoint	Asst. Prof. Dr. Wannida Sae-Tang

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Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
				• In-Class Exercises/MATLAB Programming • Assignment No. 3	
5	Pixel Sampling and Quantization	CLO 1 CLO 2 CLO 3	3.0	• Pre-Test • Lecture, Q&A/PowerPoint • In-Class Exercises/MATLAB Programming • Assignment No. 4	Asst. Prof. Dr. Wannida Sae-Tang
6	Image Filtering	CLO 1 CLO 2 CLO 3	3.0	• Pre-Test • Lecture, Q&A/PowerPoint • In-Class Exercises/MATLAB Programming • Assignment No. 5	Asst. Prof. Dr. Wannida Sae-Tang
7	Image Compression	CLO 1 CLO 2 CLO 3	3.0	• Pre-Test • Lecture, Q&A/PowerPoint • In-Class Exercises/MATLAB Programming • Assignment No. 6	Asst. Prof. Dr. Wannida Sae-Tang
8	Midterm Exam	CLO 1 CLO 3	3.0	• Paper-Based Examination	Asst. Prof. Dr. Wannida Sae-Tang
9	Project Proposal	CLO 4	3.0	• Student Presentation, Q&A/PowerPoint	Asst. Prof. Dr. Wannida Sae-Tang
10	Morphological Image Processing	CLO 1 CLO 2 CLO 3	3.0	• Lecture, Q&A/PowerPoint • In-Class Exercises/MATLAB Programming • Assignment No. 7	Asst. Prof. Dr. Wannida Sae-Tang

Week	Topics/Details	CLOs	Hours	Learning and teaching activities; teaching media (if any)	Lecturer
11	Image Registration	CLO 1 CLO 2 CLO 3	3.0	• Lecture, Q&A/PowerPoint/Academic Paper (s) • Assignment No. 8	Asst. Prof. Dr. Wannida Sae-Tang
12	Copyright- and Privacy-Protected Image Trading Systems	CLO 1 CLO 2 CLO 3	3.0	• Lecture, Q&A/PowerPoint/Academic Paper (s) • Assignment No. 9	Asst. Prof. Dr. Wannida Sae-Tang
13	Face Recognition	CLO 1 CLO 2 CLO 3	3.0	• Self-study, Q&A/Academic Paper (s) • Assignment No. 10	Asst. Prof. Dr. Wannida Sae-Tang
14	Compression of High Dynamic Range Images	CLO 1 CLO 2 CLO 3	3.0	• Self-study, Q&A/Academic Paper (s) • Assignment No. 11	Asst. Prof. Dr. Wannida Sae-Tang
15	Project Defense	CLO 4	3.0	• Student Presentation, Q&A/PowerPoint	Asst. Prof. Dr. Wannida Sae-Tang
		Total	45.0		

2. **Evaluation Plan (in accordance with OBE 2 mapping framework)**

Course Learning Outcomes (CLOs)	Evaluation Methods	Week of Evaluation	Percentage of Evaluation
CLO 1, 2, 3	11 Assignments	2-7, 10-14	30%
CLO 1, 3	1 Exam	8	40%
CLO 4	1 Project Assignment	9, 15	30%

Section 5 Teaching/Learning Resources

Textbooks and materials

Main Text: 1. W. Sae-Tang, “Digital Image Processing,” Lecture Companion

2. Digital Image Processing, by R. C. Gonzalez and R. E. Woods, Boston, MA, USA: Addison-Wesley Longman Publishing Co., Inc., 2001.

3. W. Sae-Tang, M. Sugiyama, M. Fujiyoshi, and H. Kiya, "Non-Separable Weighted Median-Cut Quantization for Images with Sparse Color Histogram," IEEE International Symposium on Intelligent Signal Processing and Communication Systems (IEEE ISPACS2012), New Taipei City, Taiwan, R.O.C., no. D2.5, pp. 473-478, Nov. 4-7, 2012.

Section 6 Course Evaluation and Improvement

1. Course evaluation by students

The students will have an opportunity to evaluate the effectiveness of the course in a form of paper survey and group interview at the end of each semester. The results of survey and interview including the grading will be reviewed by the curriculum meeting to evaluate the course's effectiveness.

2. Strategies for assessing learning management

The students will have an opportunity to evaluate the teaching of the course in a form of paper survey and group interview at the end of each semester. The results of survey and interview including the grading will be reviewed by the curriculum meeting to evaluate the teaching as well as returning to the lecturer for further improvement.

3. Improvement schemes of course implementation

The evaluation from the students including the grading will be submitted to the curriculum meeting for reviewing and brainstorming to improve teaching of each course. Comments and suggestions given by the curriculum meeting will be informed to the responsible lecturer of each course.

4. Verification of students' learning outcomes, referred to OBE 2 and 3

The grading of this course will be evaluated and reviewed by the Department meeting and the TGGS executive board meeting in order to verify its appropriateness before the final approval.

5. Course review and improvement plans

The results of the grading evaluation and student evaluation will be submitted to the curriculum meeting for reviewing and brainstorming to improve the effectiveness of the offered courses. Comments and suggestions will be informed to the responsible lecturer of each course.