37. Introduction to Digital Image Processing (PH038IU)

Module designation	*This course will introduce students to essential basic knowledge of creating, visualizing, and manipulating digital images by computer. Topics will include representation of two-dimensional (2D) data, time and frequency domain representations, filtering and enhancement, the Fourier transform, convolution, interpolation, color images, and preliminary knowledge in object recognition and description.*
Semester(s) in which the module is taught	1,2
Person responsible for the module	Dr. Hồ Đình Duẩn
Language	English
Relation to curriculum	Compulsory
Teaching methods	Lecture, lesson, homework.
Workload (incl. contact hours, self-study hours)	(Estimated) Total workload: 85 Contact hours (please specify whether lecture, exercise, laboratory session, etc.): lecture: 25 Private study including examination preparation, specified in hours: 60
Credit points/ECTS	2 credits/3.08 ECTS
Required and recommended prerequisites for joining the module	None

<table>
<tr><td>Module objectives/intended learning outcomes</td><td>Upon the successful completion of this course students will be able to:
<table>
<tr><th>Competency level</th><th>Course learning outcome (CLO)</th></tr>
<tr><td>Knowledge</td><td>CLO1: Apply systematically the theoretical aspects of imaging systems in designing, manipulating, and creating 2D digital images.</td></tr>
<tr><td>Skill</td><td>CLO2: Use advanced imaging techniques to create, visualize and manipulate digital images.</td></tr>
<tr><td>Attitude</td><td>CLO3: Show the role and responsibilities of an engineer in related fields.</td></tr>
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<tr><td>Content</td><td>

The description of the contents should clearly indicate the weighting of the content and the level.

Weight: lecture session (3 hours)

Teaching levels: I (Introduce); T (Teach); U (Utilize)

<table>
<tr><th>Topic</th><th>Weight</th><th>Level</th></tr>
<tr><td>Introduction and organization, physics of vision, resolution, impulse response</td><td>1</td><td>I, T</td></tr>
<tr><td>Linear systems, matrix transformations, scaling, translation, rotations and other geometric transformation; image registration and interpolation</td><td>1</td><td>I, T</td></tr>
<tr><td>Contrast and gray levels, histograms, Gaussian, and other non-linear stretches</td><td>1</td><td>I, T</td></tr>
<tr><td>Convolution, simple filters, edge detection</td><td>1</td><td>I, T</td></tr>
<tr><td>The frequency domain, power spectral density, the FFT</td><td>1</td><td>I, T</td></tr>
<tr><td>Digital filtering, image enhancement, noise</td><td>1</td><td>I, T</td></tr>
<tr><td>The fast Fourier transforms</td><td>1</td><td>I, T</td></tr>
<tr><td>The convolution theorem</td><td>1</td><td>I, T</td></tr>
<tr><td>Color representation, RGB, HSI, 24 bit and 8 bit color tables</td><td>1</td><td>I, T</td></tr>
<tr><td>3D information, perspective plots</td><td>1</td><td>I, T</td></tr>
<tr><td>Topography and shaded relief display, contours, parallax, and stereo</td><td>1</td><td>I, T</td></tr>
<tr><td>Image morphing</td><td>1</td><td>I, T</td></tr>
<tr><td>Interpolation</td><td>1</td><td>I, T</td></tr>
<tr><td>Fitting smooth functions to sparse data, least-squares</td><td>1</td><td>I, T</td></tr>
<tr><td>False color images, principal components analysis</td><td>1</td><td>I, T</td></tr>
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<tr><td>Examination forms</td><td>Exam</td></tr>
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Study and examination requirements	Attendance: A minimum attendance of 80 percent is compulsory for the class sessions. Students will be assessed on the basis of their class participation. Questions and comments are strongly encouraged. Assignments/Examination: Students must have more than 50/100 points overall to pass this course.
Reading list	**Textbooks:** [1] Handouts [2] Scott Umbaugh (1998). *Computer Vision and Image Processing,* Prentice-Hall, Inc., Upper Saddle River, New Jersey. **References:** *[3]* Abramowitz, M., and I. A. Stegun (1964). *Handbook Of Mathematical Functions with Formulas, Graphs, And Mathematical Tables,* U.S. Govt. Print. Off., Washington. [4] Bracewell, R. N. (1986). *The Fourier Transform and Its Applications,* McGraw-Hill, New York, 2nd edition. *[5]* Goodman, J.W. (1968). *Introduction to Fourier Optics*, McGraw-Hill, New York. *[6]* Pratt, W.K. (1978). *Digital Image Processing,* John Wiley and Sons, New York. [7] Lillesand and Kiefer (1994). *Remote Sensing and Image Interpretation,* Third Edition, Wiley, New York.