Subject Description Form

Subject Code	EIE529
Subject Title	Digital Image Processing
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Calculus, linear algebra and basic statistics. Some programming (preferably MATLAB). Basic understanding of Digital Signal Processing.
Objectives	This subject is to enable students to learn a number of important applications of digital image processing. After the completion of the subject, students should be able to appreciate and master some image and vision techniques for industrial applications. This subject is also suitable for students who are preparing to carry out research in related areas.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the fundamentals of image processing and associated techniques. b. Solve practical problems with basic image processing techniques. c. Design simple systems for realizing applications with basic image processing techniques.
Subject Synopsis/ Indicative Syllabus	1. Introduction: Digital image representation and visual perception. Review on the Fourier transform and linear time-invariant systems. Discrete Fourier analysis of multi-dimensional signals, multi-dimensional filtering. 2. Introduction to the Wavelet Transform: Discrete wavelet transform for one-dimensional and two-dimensional signals, choices of wavelet filters, applications of the wavelet transform in image processing. 3. Image Enhancement: Simple intensity transformation, histogram processing. Spatial filtering. Bilateral filtering. 4. Image Restoration: Degradation model, noise model. Wiener filter. Block matching method for image denoising. Deconvolution and inverse filtering, constrained least square method for image deblurring. Introduction to blind deconvolution. 5. Image Coding and Compression Techniques: Transform image coding, Karhunen-Loeve transform (KLT), discrete cosine transform (DCT), blocking effect. Scalar and vector quantization. Codeword assignment, entropy coding. Industrial standard: JPEG. 6. Image Segmentation: Optimum thresholding. Morphological watershed method. K-means clustering. Segmentation with superpixels. Graph cuts method. 7. Feature Extraction: Shape descriptors, Freeman chain code, Fourier descriptor. Region descriptors, feature vector and feature space, statistical approach for texture description. Scale-invariant feature transform (SIFT).

Teaching/Learning Methodology

Method	Remarks
Lectures	Fundamental principles and key concepts of the subject are delivered to students.
Tutorials	Students will be able to clarify concepts and have a deeper understanding of the lecture material; problems and application examples are given and discussed.
Laboratory sessions	Students will make use of the software MATLAB to simulate various image processing techniques and evaluate their performance.
Mini-Project	Students will do further reading, search for information, keep abreast of current development, share their findings with other classmates through presentations, and write a report.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
Lectures	✓	✓	✓
Tutorials	✓	✓	✓
Laboratory sessions	✓	✓	✓
Mini-Project	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Assignments	15%	✓	✓	✓
2. Laboratory demonstration and reports	15%	✓	✓	✓
3. Test/Quizzes	40%	✓	✓	✓
4. Mini-Project	30%	✓	✓	✓
Total	100%			

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial/Laboratory	39 Hrs.
Other student study effort:	
▪ Homework, lab report, and self-study	36 Hrs.
▪ Mini-project: Studying, writing a report, and preparing presentations	30 Hrs.
Total student study effort	105 Hrs.

Reading List and

1. R.C. Gonzalez and P. Wintz, *Digital Image Processing*, 4th ed., Pearson, 2018.

References	2. R.C. Gonzalez, R. E. Woods and S. L. Eddins, *Digital Image Processing using Matlab*, Prentice Hall, 2004. 3. Bovik, *Handbook of Image and Video Processing*, Academic Press, 2000. 4. Selected Reading from recent issues of *IEEE Transactions on Acoustics, Speech, and Signal Processing, IEEE Transactions on Image Processing, etc*.

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