AEEE514 - Digital Image Processing

Course Title	Digital Image Processing				
Course Code	AEEE514				
Course Type	Technical Elective				
Level	Masters (Level 2)				
Year / Semester	1 or 2				
Teacher's Name	Prof Michael Komodromos				
ECTS	8	Lectures / week	3	Laboratories/week	
Course Purpose	The aim of the course is to familiarize students with the fundamental concepts and methodologies for digital image processing, and as a result, develop the necessary knowledge to be used as foundation for further study and research in the field.				
Learning Outcomes	By the end of the course, students must be able to: 1. Differentiate among the various areas of image processing. Describe the basic components of a general-purpose image processing system and explain the fundamental steps in digital image processing. 2. Setup the image processing problem and decide how the various image enhancement techniques in the spatial and frequency domains will improve the image. Evaluate a given image and determine the appropriate mask for a specific enhancement requirement. Design and use various filters to process images accordingly. 3. Formulate and analyze high order statistics filters, median filters, and max-min filters. Describe the use of edge detection techniques and image interpolation. Evaluate the results of the various image enhancement techniques. 4. Distinguish and apply various image restoration techniques and evaluate their results. 5. Use image processing MATLAB software tools for solving image processing problems. 6. Recognise the various regions of current research in image processing and appreciate the need of image processing in specific contemporary scientific applications.				
Prerequisites	Advisor Approval		Corequisites	None	
Course Content	• ***Applications*** of image processing. • ***Formation of digital images***. Image sensing, acquisition sampling and quantization. Spatial and Gray level resolution. Encoding. • ***Image enhancement in the spatial domain***. Gray level transformations. Histogram processing. Spatial filtering. Smoothing filters. Order statistic filters. Sharpening spatial filters. Laplacian. Combination of spatial enhancement methods. • ***Image Enhancement in the frequency domain***. Fourier transform and				

	frequency domain. Two-dimensional Fourier Transform. DFT and its inverse. Smoothing frequency filters. Sharpening frequency domain filters. Homomorphic filters. • ***Image Restoration.*** Modelling of the degradation-restoration process. Types of noise. Mean filters, order-statistics filters. Frequency domain filtering. Wiener and least squares filtering. • ***Image Compression.*** Redundancy. Image compression models. • ***Selected Advanced Topics.*** Morphological image processing, Image segmentation and object recognition. • **Advances in Technology and Current Trends in Research:** Examine and discuss the current state of the technology in signal processing systems and new applications. Overview current trends in research and new technological and scientific challenges in signal processing. Journal paper review. • ***MATLAB*** processing of images using the Image Processing Toolbox.
Teaching Methodology	Teaching of the course is based on lectures (3 hours per week) in a classroom, using a mixture of traditional teaching with notes on the white board and slide presentations using a projector where appropriate. Topic notes are compiled by students, during the lectures which serve to cover the material of the course. Students are urged to use the textbook assigned to the course. Homework problems are assigned from the textbook as a turn-in assignment or for interactive homework practice. Additionally, students are advised to use the reference books for further reading and practice in solving related exercises. Example problems are solved during lectures or privately during the lecturer's office hours. Students are assessed continuously and their knowledge is checked through tests and assignments. Analysis and design problems that require the use of MATLAB and its packages are assigned.
Bibliography	**Textbook:** R. Gonzales and R. Woods, *Digital Image Processing,* Prentice Hall, 4th edition, 2018. **References:** J. Russ, Introduction to Image processing and analysis, CRC press,2007. W. Pratt, Digital Image Processing, 4th edition, J. Wiley, 2007 A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989.
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. The continuous assessment of the students is achieved through assignments and tests. An indicative weighted continuous assessment of the course is shown below: • Assignments 25% • Design Project 15% • Exams and Quizzes 60% Students are prepared for the final exam through revisions on the material taught, problem solving and concept testing. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	**English**