AEEE505 - Digital Signal Processing

Course Title	Digital Signal Processing				
Course Code	AEEE505				
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 signal processing, and as a result, develop the necessary knowledge to be used as foundation for further study and research in the field or related areas for which signal processing is essential.				
Learning Outcomes	By the end of the course, students must be able to: 1. Characterize fully analyze and manipulate discrete-time signals in the time domain and in the frequency domain using Fourier analysis. 2. Analyze discrete-time systems in the time domain using difference equations and the impulse response. Categorize and evaluate FIR and IIR systems. Construct block diagram implementations of discrete-time systems. 3. Compute the z and Fourier transforms of discrete time functions and use them to analyze discrete-time signals and systems. Compute the transfer function, the frequency response, the impulse response and the output of systems. 4. Formulate the general digital filter design problem. Design and analyze digital filters and evaluate the various FIR and IIR filter design methods. 5. Evaluate the Discrete Fourier Transform (DFT) and Fast Fourier transform (FFT) of discrete-time signals. Appreciate their use in DSP applications. 6. Demonstrate skill and understanding in the use of MATLAB DSP tools for the analysis of discrete-time signals and the design and implementation of discrete-time systems.				
Prerequisites	Advisor Approval		Corequisites	None	
Course Content	***Introduction:*** Advantage of digital signal processing systems. Applications. Classification of signals. Concepts of sampling and analog to digital conversion. ***Discrete time signals and Systems:*** Signal operations. Properties. Useful signals. Correlation. Linearity, shift-invariance and causality of discrete time				

	systems. Input output description of systems. Difference equation. Impulse response and convolution. Block diagram representations. Cascaded systems. Recursive and non-recursive realizations of systems. *The z-transform:* Properties. Rational z-transforms, poles and zeros, causality and stability. Location of poles and zeros and system behavior. Inverse z-transform and partial fraction expansion. Stability tests. *Frequency analysis of signals and systems:* Fourier Transform of discrete time signals. Power density spectrum and cepstrum. Frequency response of discrete time systems. Magnitude and phase. Group delay. Ideal filters and their frequency response. ***Discrete Fourier Transform:*** Properties and applications. Frequency analysis of signals using the DFT. Linear filtering based on the DFT. Fast Fourier Transform (FFT) algorithms and its applications. ***Digital Filter Design and Implementation:*** Selected topics in the design and implementation of FIR and IIR digital filters. ***Selected Topics:*** Selected topics in Linear prediction and optimum linear filters. Basics of Wiener filtering, adaptive filtering and the LMS algorithm. ***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*** Use of the Signal Processing Toolbox for all of the above.
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. Additionally, analysis and design problems that require the use of MATLAB and its packages are assigned.
Bibliography	**Textbook:** J. Proakis and D. Manolakis, *Digital Signal Processing*, 4th edition, Prentice Hall, 2007. **References:** A.V. Oppenheim and R.W. Schafer **(O & S)**, *Discrete-time Signal Processing*, 3rd ed., Prentice-Hall, 2009. J. R. Johnson, *Introduction to Digital Signal Processing,* Prentice Hall, 1999.

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**