<table>
<tr><td>Course Title</td><td colspan="5">Systems, Transforms and Signal Processing</td></tr>
<tr><td>Course Code</td><td colspan="5">AELE310</td></tr>
<tr><td>Course Type</td><td colspan="5">Compulsory</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">3/6</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Prof Eftyvoulos Kyriacou, Dr. Lestas Marios</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3</td><td>Laboratories/week</td><td></td></tr>
<tr><td>Course Purpose</td><td colspan="5">The aim of the course is to familiarize students with the characteristics and manipulation of continuous-time signal and their analysis using Fourier series and the Fourier Transform to obtain their frequency spectra. Explain the concepts of continuous-time systems. Describe continuous-time systems using differential equations and the impulse response. Obtain the system output using convolution. Analyze LTI systems using the Laplace Transform and the Fourier Transform. Obtain the frequency responses of systems and analyze their behavior in the frequency domain. The course includes a laboratory session emphasizing on applied signal processing.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">By the end of the course, students must be able to:<br>1. Categorize the various types of signals. Recognize and manipulate special signals. Understand and calculate quantities such as average value, RMS value, instantaneous power and average power of signals. Perform mathematical operations on signals such as amplitude scaling, time scaling, addition and subtraction.<br>2. Classify continuous time systems based on linearity, time invariance and causality. Derive the convolution integral. Use convolution to calculate the output of a system, graphically and analytically, given its impulse response and the input. Compute the impulse response of cascaded systems.<br>3. Compute the Fourier series of periodic waveforms and the Fourier transform of non-periodic waveforms. Employ the Fourier series and the Fourier transform to obtain the frequency spectra of signals.<br>4. Compute the Laplace Transform of signals. Analyze LTI systems using the Laplace transform and the Fourier transform. Obtain the transfer function, frequency response and test their stability. Derive the impulse response of LTI systems from the transfer function using partial fraction expansion.<br>5. Integrate the knowledge attained to compute the impulse response, the transfer function and the frequency response of simple electrical systems. Derive the impulse response of ideal filters. Specify, design and analyze simple analog filters. Classify filters in terms of their frequency response.<br>6. Implement digital signal processing operations such as digital filtering using a high level language.</td></tr>
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| Prerequisites | AMAT204 | Corequisites | None |
| Course Content | ***Signals:*** Classifications. Operations on signals: amplitude and time scaling, addition. Special signals: Unit step, Unit impulse, sinusoidal, exponential, complex exponential.<br><br>***Systems:*** Classification of continuous-time systems and their properties. Linearity, time invariance, causality and stability. Description of continuous-time systems using differential equations. General forms. Impulse response. Input output description and the convolution integral. Graphical interpretation of convolution.<br><br>***Fourier series:*** Derivation of the trigonometric Fourier series. Calculation of the Fourier coefficients. Combined trigonometric and exponential forms of the Fourier series. Harmonics and frequency spectra. Average value, RMS value, instantaneous and average power of periodic signals.<br><br>***Laplace Transform:*** Definition. Laplace transform of functions. Properties. Inverse Laplace transform using partial fraction expansion. Application of the Laplace transform to continuous-time linear systems analysis. Transfer function, poles and zeros, BIBO stability.<br><br>***Fourier Transform:*** Definition. Properties. Fourier transform of functions. Frequency spectra of signals. Frequency response of LTI systems. Magnitude and phase responses.<br><br>***Filters***: Introduction to filters. Ideal filters. Specification of filters in terms of their frequency response. Magnitude and phase responses of filters. Group delay. Digital filters (FIR and IIR) and the Fast Fourier Transform. Laboratory implementation of digital filters and applications with digital filters. | | |
| 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. | | |
| Bibliography | **(a) <u>Textbooks:</u>**<br><br>Philips, J. Parr, E. Riskin, Signals, Systems, and Transforms, Pearson Education International, 5th edition, 2013.<br><br>**(b) <u>References:</u>**<br><br>L. Balmer, *Signals and Systems*, Prentice – Hall International, 1997.<br>Leland B. Jackson, *Signals, Systems and Transforms,* Addison Wesley, 2001.<br>Al. Oppenheim, Al. Willsky, *Signals and Systems,* 2nd edition, | | |

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| | Prentice Hall, 1997. |
| 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 60% and 40%, respectively, and compose the final grade of the course.<br><br>The continuous assessment of the students is achieved through assignments and tests. An indicative weighted continuous assessment of the course is shown below:<br><br>• Assignments 20%<br>• Tests 20%<br>• Labs 20%<br>• Exams and Quizzes 40% |
| Language | **English** |