ESE-2014 Digital Signal Processing and Storage

Computer Studies

Course Number:	Co-Requisites:	Pre-Requisites:
ESE-2014	N/A	ESE-1005
Prepared by:	Jay Nadeau, Outline Creator	
Approved by:	Chris Slade, Dean Computer Studies and International Education	
Approval Date:	Monday, June 11, 2018	
Approved for Academic Year:	2018-2019	
Normative Hours:	60.00	

Course Description

Students are introduced to the analysis and representation of continuous-time, discrete-time and linear time-invariant systems. Students learn both the theory and practice of such topics as difference equations, discrete-time convolution, the z-transform, discrete-time Fourier Transform and the Fast Fourier Transform algorithm. Students implement finite-impulse response and infinite-impulse response filters. DAC and ADC theory and application will be studied. Students also design and implement an application that computes the discrete Fourier Transform using the Fast Fourier Transform(FFT)algorithm.

Course Learning Outcomes/Course Objectives

1. **Differentiate continuous and discrete in time signals and the representation of continuous signals as discrete signals.**
   - 1.1 Describe the differences between analog and digital signals.
   - 1.2 Describe introductory concepts of digital signal filtering.
   - 1.3 Identify elements of a digital signal processing system.
   - 1.4 Explain differences between low-pass, high-pass, band-pass and band-reject filtering.
   - 1.5 Describe differences between continuous time, discrete time, continuous valued and discrete valued signals.
   - 1.6 Explain sampling and quantization of signals.

2. **Describe discrete time and LTI systems and compute the convolution and correlation of discrete time LTI signals.**
   - 2.1 List elementary discrete-time signals.
   - 2.2 Explain the difference between energy and power signals.

2.3 Explain differences between periodic and aperiodic signals and even and odd signals.

2.4 Explain differences between time-invariant and time-variant and linear and non-linear systems.

2.5 Describe the meaning of causal and non-causal systems.

2.6 Explain the importance of linear time invariant systems.

2.7 Explain the purpose of the convolution formula.

2.8 Compute the correlation between two signals.

3. Compute the z-transform and the discrete Fourier transform using the fast Fourier transform algorithm of signals.

3.1 Compute the Fourier series of continuous and discrete signals.

3.2 Compute the Fourier transform of continuous and discrete signals.

3.3 Compute the discrete Fourier transform of continuous and discrete signals.

3.4 Compute the DFT using the FFT algorithm.

4. Determine the frequency response of an LTI system.

4.1 Determine the frequency response of LTI systems.

4.2 Calculate and plot the magnitude and phase response of a LTI system.

4.3 Sketch the pole-zero plot of a LTI system.

4.4 Sketch the magnitude plots of Fourier transforms based on the pole-zero sketch of a LTI system.

5. Design and implement FIR and IIR digital filters.

5.1 Design FIR filters.

5.2 Determine and plot the magnitude and phase response of FIR filters.

5.3 Design IIR filters.

5.4 Determine and plot the magnitude and phase response of IIR filters.

5.5 Sketch z-plane pole-zero plots for digital filters.

5.6 Determine the system function based on z-plane pole-zero plots.

6. Convert analog signals to digital signals and digital signals to analog signals.

6.1 Draw a diagram of a basic analog to digital converter.

6.2 Draw a diagram of a basic digital to analog converter.

6.3 Describe the meaning of sampling a continuous signal.

6.4 Describe the meaning of quantization of a continuous signal.

6.5 Describe the meaning of digitizing a continuous signal.

7. Implement C++ applications to filter and process audio signals.

7.1 Add a reverberation effect to an audio signal.

7.2 Add an echo effect to an audio signal.

7.3 Add a chorus effect to an audio signal.

7.4 Add a phaser effect to an audio signal.

7.5 Add a flanger effect to an audio signal.

7.6 Remove noise from an audio signal.

8. Implement C++ applications to filter and process images.

8.1 Add a blurring effect to a 2-D image signal.

8.2 Remove a blurring effect from a 2-D image signal.

Learning Resources

a. Required

Digital Signal Processing Using MATLAB by Vinay K. Ingle and John G. Proakis; Cengage Learning, 4th ed. (Jan. 2016).

b. Supplemental

None

Student Evaluation

Tests 25%

Tests (1@10%, 1 @15%)

Assignments 15%

Assignments (3@ 5%)

Laboratory Sessions 60%

Laboratory Sessions (10 @ 6%)

Grade Scheme

The round off mathematical principle will be used. Percentages are converted to letter grades and grade points as follows:

Mark (%)	Grade	Grade Point	Mark (%)	Grade	Grade Point
94-100	A+	4.0	67-69	C+	2.3
87-93	A	3.7	63-66	C	2.0
80-86	A-	3.5	60-62	C-	1.7
77-79	B+	3.2	50-59	D	1.0
73-76	B	3.0	0-49	F	0.0
70-72	B-	2.7			

Prior Learning Assessment and Recognition

Students who wish to apply for prior learning assessment and recognition (PLAR) need to demonstrate competency at a post-secondary level in all of the course learning requirements outlined above. Evidence of learning achievement for PLAR candidates includes:

- Not Applicable: Post Graduate Course and not eligible for PLAR.

Course Related Information

Laboratory sessions will make use of a combination of MATLAB and C++ software to implement various digital signal processing techniques. Course learning outcomes 7 & 8 will be achieved during laboratory sessions.

College Related Information

Academic Integrity

Lambton College is committed to high ethical standards in all academic activities within the College, including research, reporting and learning assessment (e.g. tests, lab reports, essays).
The cornerstone of academic integrity and professional reputation is principled conduct. All scholastic and academic activity must be free of all forms of academic dishonesty, including copying, plagiarism and cheating.

Lambton College will not tolerate any academic dishonesty, a position reflected in Lambton College policy. Students should be familiar with the Students Rights and Responsibilities Policy, located on the MyLambton website. The policy states details concerning academic dishonesty and the penalties for dishonesty and unethical conduct.

Questions regarding this policy, or requests for additional clarification, should be directed to the Lambton College Centre for Academic Integrity

Students with Disabilities

If you are a student with a disability please identify your needs to the professor and/or the Accessibility Centre so that support services can be arranged for you. You can do this by making an appointment at the Accessibility Centre or by arranging a personal interview with the professor to discuss your needs.

Student Rights and Responsibility Policy

Acceptable behaviour in class is established by the instructor and is expected of all students. Any form of misbehaviour, harassment or violence will not be tolerated. Action will be taken as outlined in Lambton College policy.

Date of Withdrawal without Academic Penalty

Please consult the Academic Regulations and Registrar's published dates.

Waiver of Responsibility

Every attempt has been made to ensure the accuracy of this information as of the date of publication. The content may be modified, without notice, as deemed appropriate by the College.

Students should note policies may differ depending on the location of course offering. Please refer to campus location specific policies:

- Lambton College - Sarnia Campus: https://www.mylambton.ca/Policies/
- Lambton College - Non-Sarnia Study Locations: https://www.mylambton.ca/Lambton_in_GTA/Student_Policies/

Note: It is the student’s responsibility to retain course outlines for possible future use to support applications for transfer of credit to other educational institutions.