COURSE SYLLABUS

Camosun College campuses are located on the traditional territories of the Lək̓ʷəŋən and W̱SÁNEĆ peoples. We acknowledge their welcome and graciousness to the students who seek knowledge here.
Learn more about Camosun's Territorial Acknowledgement.

COURSE TITLE: ELEN 186 - Digital Signal Processing

TERM: 2023 Summer

COURSE CREDITS: 3

DELIVERY METHOD(S): In Person: (6 hours of lecture / 4 hours of lab weekly)

INSTRUCTOR DETAILS

NAME: Landon Brown

EMAIL: BrownLa@camosun.ca

OFFICE: TEC 215

CALENDAR DESCRIPTION

This course in digital signal processing starts with DSP fundamentals, including sampling, quantization, A/D and D/A conversion, digital signals, difference equations, impulse and step responses, convolution, z transforms, transfer functions, poles and zeros, and stability.

It then moves on to investigates frequency response, filter shape, digital signal spectra, finite impulse response filters, infinite impulse response filters, correlation and autocorrelation, discrete time Fourier transforms and fast Fourier transforms, and basics of DSP hardware. In addition, the course surveys a variety of signal processing applications of DSP.

COURSE LEARNING OUTCOMES / OBJECTIVES

Upon successful completion of this course a student will be able to:

- describe the elements of a DSP system
- define sampling, aliasing and quantization and the errors they introduce
- use non-recursive and recursive filter difference equations to determine filter outputs
- draw a difference equation diagram
- compute the impulse and step responses of a filter
- perform convolution to find filter outputs
- convert between a system's transfer function and its difference equation
- use z transforms to find filter outputs
- identify poles and zeros of a filter and assess filter stability and filter behaviour
- apply a discrete time Fourier transform to find spectra and frequency responses
- apply a discrete time Fourier transform to find the frequency response of a filter
- describe the behaviour and characteristics of FIR filters
- explain principles of FIR windowing
- design FIR filters using basic techniques
- apply the bilinear transformation to create an IIR filter
- list differences between Butterworth and Chebyshev filters
- select filter order given IIR filter specifications
- list significant DSP architecture issues, including hardware and software
- describe signal and image processing applications
- explain the principles of DSP applications in CANTASS, Link11, and STIRS

REQUIRED MATERIALS & RECOMMENDED PREPARATION / INFORMATION

Website on D2L.

Text: van de Vegte, Fundamentals of Digital Signal Processing

COURSE SCHEDULE, TOPICS, AND ASSOCIATED PREPARATION / ACTIVITY / EVALUATION

The following schedule and course components are subject to change with reasonable advance notice, as deemed appropriate by the instructor.

HOURS	TOPIC
3	**Overview** Applications of DSP Signals Spectra A/D and D/A conversion Filters Linear time invariant systems
8	**A/D and D/A Conversion** Simple DSP system Sampling Quantization Aliasing A/D conversion D/A conversion Ch. 2 2.1 - 2.7, 2.9, 2.11, 2.13, 2.15, 2.19, 2.25, 2.27
4	**Digital Signals** Notation and representation 1D digital signals (impulse, step, exponential, sinusoidal) 2D digital signals (images, sonar) Ch. 3 3.1 - 3.6, 3.9, 3.10, 3.16 - 3.19, 3.23
5	**Difference Equations** Digital filtering Difference equation structure Non-recursive difference equations Moving average filters Recursive difference equations Difference equation diagrams

HOURS	TOPIC
	Impulse response (FIR and IIR) Step response General outputs Ch. 4 4.9, 4.11, 4.13, 4.15, 4.16, 4.24, 4.25, 4.27, 4.28, 4.30, 4.32 Problem Set 1
4	**Convolution** Filtering by convolution Moving average filters by convolution Filtering digital images Ch. 5 5.4, 5.5, 5.6, 5.13, 5.17, 5.18, 5.19
4	**Correlation and Autocorrelation** Correlation definition and uses Autocorrelation definition and uses Signal detection in noise Problem Set 2
7	**z Transforms** Table of z transforms Transfer functions Poles, zeros and stability Inverse z transforms Computing filter outputs Ch 6 6.6 - 6.8, 6.15abd, 6.17, 6.18, 6.23, 6.28, 6.30, 6.31, 6.34 Problem Set 2
2	**Filters** Filter behaviour Filter types Bode plots
8	**Frequency Response** Frequency response Filter shape Filter shape from poles and zeros

HOURS	TOPIC
	Ch. 7 7.7, 7.10, 7.17, 7.24, 7.25
11	**Finite Impulse Response Filters** FIR filter specification and characteristics Phase distortion Ideal low pass filter Windowing Designing low pass FIR filters Band pass, high pass and band stop FIR filters Practical considerations Ch. 9 9.1, 9.4, 9.6ab approx c, 9.12, 9.13, 9.15, 9.16, 9.20a, 9.21, 9.23, 9.26
8	**Discrete Fourier Transform (DFT) and Fast Fourier Transform** Computing the DFT DFT resolution Interpreting the DFT Spectrograms Relationship between FFT and DFT Ch. 11 11.2a, 11.4, 11.12, 11.13, 11.15, 11.16, 11.18, 11.21 Problem Set 3
4	**Infinite Impulse Response Filters** Characteristics of IIR Filters IIR Filters Derived from Analog Designs Bilinear Transformation Impulse Invariance IIR Design Ch. 10 10.3, 10.4abcd, 10.5, 10.6a, 10.7, 10.8, 10.15a, 10.21
3	**DSP Hardware and Applications** DSP architectures DND Applications (CANTASS Sonar, STIR Fire Control, LINK-11) Digital audio Speech recognition Image processing

Lab posting and due dates may be found on D2L.

EVALUATION OF LEARNING

DESCRIPTION		WEIGHTING
Quizzes		5%
Problem Sets (3 total)		5%
Test 1 (Week 5): Wednesday May 31st Test 2 (Week 10): Wednesday July 5th		30%
Labs		30%
Final exam: To pass the course, students must obtain a minimum of 50% on the final exam.		30%
If you have a concern about a grade you have received for an evaluation, please come and see me as soon as possible. Refer to the Grade Review and Appeals policy for more information. http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf	TOTAL	100%

COURSE GUIDELINES & EXPECTATIONS

Problem sets will be assigned but not graded. Solution sets will be posted. To be successful in the course, you must achieve 60% on theory and 60% on lab, including a minimum 50% on the final exam.

SCHOOL OR DEPARTMENTAL INFORMATION

Electronics & Computer Engineering Technology
Chair: John Yang

STUDENT RESPONSIBILITY

Enrolment at Camosun assumes that the student will become a responsible member of the College community. As such, each student will display a positive work ethic, assist in the preservation of College property, and assume responsibility for their education by researching academic requirements and policies; demonstrating courtesy and respect toward others; and respecting expectations concerning attendance, assignments, deadlines, and appointments.

SUPPORTS AND SERVICES FOR STUDENTS

Students registered with the Centre for Accessible Learning (CAL) who complete quizzes, tests, and exams with academic accommodations have booking procedures and deadlines with CAL where advanced noticed is required. Deadlines scan be reviewed on the CAL exams page. http://camosun.ca/services/accessible-learning/exams.html

Camosun College offers a number of services to help you succeed in and out of the classroom. For a detailed overview of the supports and services visit http://camosun.ca/students/.

Support Service	Website
Academic Advising	http://camosun.ca/advising
Accessible Learning	http://camosun.ca/accessible-learning
Counselling	http://camosun.ca/counselling
Career Services	http://camosun.ca/coop
Financial Aid and Awards	http://camosun.ca/financialaid
Help Centres (Math/English/Science)	http://camosun.ca/help-centres
Indigenous Student Support	http://camosun.ca/indigenous
International Student Support	http://camosun.ca/international/
Learning Skills	http://camosun.ca/learningskills
Library	http://camosun.ca/services/library/
Office of Student Support	http://camosun.ca/oss
Ombudsperson	http://camosun.ca/ombuds
Registration	http://camosun.ca/registration
Technology Support	http://camosun.ca/its
Writing Centre	http://camosun.ca/writing-centre

If you have a mental health concern, please contact Counselling to arrange an appointment as soon as possible. Counselling sessions are available at both campuses during business hours. If you need urgent support after-hours, please contact the Vancouver Island Crisis Line at 1-888-494-3888 or call 911.

COLLEGE-WIDE POLICIES, PROCEDURES, REQUIREMENTS, AND STANDARDS

Academic Accommodations for Students with Disabilities

The College is committed to providing appropriate and reasonable academic accommodations to students with disabilities (i.e. physical, depression, learning, etc). If you have a disability, the Centre for Accessible Learning (CAL) can help you document your needs, and where disability-related barriers to access in your courses exist, create an accommodation plan. By making a plan through CAL, you can ensure you have the appropriate academic accommodations you need without disclosing your diagnosis or condition to course instructors. Please visit the CAL website for contacts and to learn how to get started: http://camosun.ca/services/accessible-learning/

Academic Integrity

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.13.pdf for policy regarding academic expectations and details for addressing and resolving matters of academic misconduct.

Academic Progress

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.1.pdf for further details on how Camosun College monitors students' academic progress and what steps can be taken if a student is at risk of not meeting the College's academic progress standards.

Course Withdrawals Policy

Please visit http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.2.pdf for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit http://camosun.ca/learn/fees/#deadlines.

Grading Policy

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf for further details about grading.

Grade Review and Appeals

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf for policy relating to requests for review and appeal of grades.

Mandatory Attendance for First Class Meeting of Each Course

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable reason in advance, you will be removed from the course and the space offered to the next waitlisted student. For more information, please see the "Attendance" section under "Registration Policies and Procedures" (http://camosun.ca/learn/calendar/current/procedures.html) and the Grading Policy at http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf.

Medical / Compassionate Withdrawals

Students who are incapacitated and unable to complete or succeed in their studies by virtue of serious and demonstrated exceptional circumstances may be eligible for a medical/compassionate withdrawal. Please visit

http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.8.pdf to learn more about the process involved in a medical/compassionate withdrawal.

Sexual Violence and Misconduct

Camosun is committed to creating a campus culture of safety, respect, and consent. Camosun's Office of Student Support is responsible for offering support to students impacted by sexual violence. Regardless of when or where the sexual violence or misconduct occurred, students can access support at Camosun. The Office of Student Support will make sure students have a safe and private place to talk and will help them understand what supports are available and their options for next steps. The Office of Student Support respects a student's right to choose what is right for them. For more information see Camosun's Sexualized Violence and Misconduct Policy: http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.9.pdf and camosun.ca/sexual-violence. To contact the Office of Student Support: oss@camosun.ca or by phone: 250-370-3046 or 250-3703841

Student Misconduct (Non-Academic)

Camosun College is committed to building the academic competency of all students, seeks to empower students to become agents of their own learning, and promotes academic belonging for everyone. Camosun also expects that all students to conduct themselves in a manner that contributes to a positive, supportive, and safe learning environment. Please review Camosun College's Student Misconduct Policy at http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.5.pdf to understand the College's expectations of academic integrity and student behavioural conduct.

Changes to this Syllabus: Every effort has been made to ensure that information in this syllabus is accurate at the time of publication. The College reserves the right to change courses if it becomes necessary so that course content remains relevant. In such cases, the instructor will give the students clear and timely notice of the changes.