



## COURSE OUTLINE WINTER 2023

	<b>Date</b>	<b>Initials</b>
<b>Prepared by Instructor</b>	02-Jan	NRB
<b>Approved by Head</b>		

### 1. Calendar Information

#### **ENEL 593 Digital Filters**

Recursive and non-recursive systems. Time-domain and frequency-domain analysis. Z-transform, bilinear transform and spectral transformations. Filter structures and non-ideal performance.

Course Hours: 3 units; H(3-1T-2/2)

Academic Credit: 3

Calendar Reference: <http://www.ucalgary.ca/pubs/calendar/current/electrical-engineering.html#7649>

### 2. Learning Outcomes

At the end of this course, you will be able to:

- 1 Determine the characteristic equation of Infinite-Impulse Response (IIR) discrete-time systems, their real-valued or complex-valued natural modes, and the zero-input response due to non-zero initial conditions.
- 2 Determine the steady-state frequency response of discrete-time systems, both algebraically from the difference equation and also by geometric construction using the system pole-zero diagram.
- 3 Use the z-transform to analyze discrete-time signals and systems, and to understand some important properties such as the region of convergence, the relationship with the Laplace transform and Fourier transforms, and performing partial fraction expansion (PFE).
- 4 Understand Finite Impulse Response (FIR) filters, their linear-phase properties, and simple FIR-filter design methods.
- 5 Design Infinite Impulse Response (IIR) filters via the bilinear transform using continuous-domain prototype Butterworth, Chebychev, elliptic filters; also to know how to use spectral transformations to obtain highpass, bandpass, bandstop filter design from lowpass prototypes.
- 6 Become familiar with basic filter structures, including direct-form, canonical structures, parallel and cascade forms.
- 7 Understand non-ideal performance issues due to finite-precision arithmetic, including consequences of multiplier coefficient quantization, overflow, etc.

### 3. Timetable

Section	Day(s) of the Week	Time	Location
LEC 01	MWF	10:00-10:50	HNSC 122
LAB B01	TBA	TBA	WEB-BASED
TUT T01	R	14:00-14:50	SA 106

## 4. Course Instructors

### Course Coordinator

Section	First Name	Family Name	Phone	Office	Email
All	Norm	Bartley	(403) 220-5060	ICT 306	<a href="mailto:nbartley@ucalgary.ca">nbartley@ucalgary.ca</a>

## 5. Assessments

The following assessments will be given in the course. All examinations and quizzes will be *in-person*, *closed-book* and *closed-notes*.

1. **Midterm Test:** The midterm is tentatively scheduled for Wednesday, March 1, 10:00-10:50 AM in our regularly scheduled classroom HNSC 122.
2. **Final Examination:** Duration 3 hours, to be scheduled by the Registrar's Office.
3. **Quizzes:** Four (4) quizzes in total, spaced roughly two weeks apart through the term. Each quiz will be 50 minutes in length. They will be held during tutorial periods, unless otherwise notified. We will count the best three of the four quiz scores.

Five (5) lab reports will also be due during the semester.

### **Missed Assessments:**

Process for missed assessment due to illness or domestic affliction:

Immediately notify the course instructor via email. NOTE: You should not disclose personal medical details to the instructor & a medical note is not required.

If students miss a required component of the course during the term such as a quiz or exam they must contact the instructor by email as soon as possible and within 24 hours of the scheduled assessment. Depending on the situation, the instructor reserves the right to move the weight to another similar component of the course, offer a make-up assessment, or move the weight to the final exam.

### **Reappraisals of Term Work:**

For reappraisals of term work or final assessments, please refer to the SSE Reappraisal of Graded Term Work and Academic Assessments Policy and forms available on the Engineering Student Center "ESC" D2L site.

## 6. Use of Calculators in Examinations

You may use any calculator you wish for all assessments in the course. Please note that no laptop computers, tablets, personal digital assistants, cellular phones, or other electronic devices will be permitted during quizzes and exams.

## 7. Final Grade Determination

The final grade in this course will be based on the following components:

Component	Learning Outcome(s) Evaluated	Weight
Assignments	1-6	0%
Laboratory Work	1-7	20%
Quizzes	1-6	15%
Midterm Examination	1-2	15%
Final Examination	1-6	50%

**Total:**

100%
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Notes:

(a) It is not necessary to earn a passing grade on the final exam in order to pass the course as a whole.

(b) Conversion from a score out of 100 to a letter grade will be done using the conversion chart shown below. This grading scale can only be changed during the term if the grades will not be lowered.

Letter Grade	Total Mark (T)
A+	$T \geq 92.0\%$
A	$81.0\% \leq T < 92.0\%$
A-	$76.5\% \leq T < 81.0\%$
B+	$72.0\% \leq T < 76.5\%$
B	$67.5\% \leq T < 72.0\%$
B-	$63.0\% \leq T < 67.5\%$
C+	$58.5\% \leq T < 63.0\%$
C	$54.0\% \leq T < 58.5\%$
C-	$49.5\% \leq T < 54.0\%$
D+	$45.0\% \leq T < 49.5\%$
D	$40.5\% \leq T < 45.0\%$
F	$T < 40.5\%$

## 8. Textbook

There is no required textbook for this course.

## 9. University of Calgary Policies and Supports

### SSE ADVISING AND POLICIES

All Schulich School of Engineering students have access to a D2L site titled "Engineering Student Centre". Students have a responsibility to familiarize themselves with the policies available on this site.

## ACADEMIC MISCONDUCT

Academic Misconduct refers to student behavior which compromises proper assessment of a student's academic activities and includes: cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar. The SSE Academic Misconduct Operating Standard can be found on the Engineering Student Center D2L site.

For more information on the University of Calgary Student Academic Misconduct Policy and Procedure please visit:

<https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Academic-Misconduct-Procedure.pdf>

Additional information is available on the Academic Integrity Website at <https://ucalgary.ca/student-services/student-success/learning/academic-integrity>.

## ACADEMIC ACCOMODATION

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The Student Accommodations policy is available at <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf>

Students needing an accommodation based on disability or medical concerns should contact Student Accessibility Services (SAS) in accordance with the Procedure for Accommodations for Students with Disabilities (<https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>). SAS will process the request and issue letters of accommodation to instructors. For additional information on support services and accommodations for students with disabilities, visit [www.ucalgary.ca/access/](http://www.ucalgary.ca/access/).

Students needing an accommodation in relation to their coursework or to fulfil requirements for a degree based on a Protected Ground other than Disability, should communicate this need by submitting a SSE Request for Academic Accommodation Form (ESC D2L - Forms) to the Associate Head (Undergraduate Studies) within 10 business days prior to the class, test, exam, or assignment at issue.

### INSTRUCTOR INTELLECTUAL PROPERTY

Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

### FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY

Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary.

### COPYRIGHT LEGISLATION

All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (<https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Acceptable-Use-of-Material-Protected-by-Copyright-Policy.pdf>) and requirements of the copyright act (<https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html>) to ensure they are aware of the consequences of unauthorised sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Non-Academic-Misconduct-Policy.pdf>.

### MEDIA RECORDING (if applicable)

Please refer to the following statement on media recording of students: [https://elearn.ucalgary.ca/wp-content/uploads/2020/05/Media-Recording-in-Learning-Environments-OSP\\_FINAL.pdf](https://elearn.ucalgary.ca/wp-content/uploads/2020/05/Media-Recording-in-Learning-Environments-OSP_FINAL.pdf)

#### *\*Media recording for lesson capture*

The instructor may use media recordings to capture the delivery of a lecture. These recordings are intended to be used for lecture capture only and will not be used for any other purpose. Although the recording device will be fixed on the Instructor, in the event that incidental student participation is recorded, the instructor will ensure that any identifiable content (video or audio) is masked, or will seek consent to include the identifiable student content to making the content available on University approved platforms.

#### *\*Media recording for self-assessment of teaching practices*

The instructor may use media recordings as a tool for self-assessment of their teaching practices. Although the recording device will be fixed on the instructor, it is possible that student participation in the course may be inadvertently captured. These recordings will be used for instructor self-assessment only and will not be used for any other purpose.

#### *\*Media recording for the assessment of student learning*

The instructor may use media recordings as part of the assessment of students. This may include but is not limited to classroom discussions, presentations, clinical practice, or skills testing that occur during the course. These recordings will be used for student assessment purposes only and will not be shared or used for any other purpose.

### SEXUAL VIOLENCE POLICY

The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Sexual-and-Gender-Based-Violence-Policy.pdf>

### OTHER IMPORTANT INFORMATION

Please visit the Registrar's website at: <https://www.ucalgary.ca/registrar/registration/course-outlines> for additional important information on the following:

- Wellness and Mental Health Resources
- Student Success
- Student Ombuds Office
- Student Union (SU) Information
- Graduate Students' Association (GSA) Information
- Emergency Evacuation/Assembly Points
- Safewalk

## **10. Additional Course Information**

### Course Format and Scheduling

Unless otherwise notified, lectures and tutorials will be conducted in-person according to the timetable given in Section 3. Labs are MATLAB-based and can be carried at any time, subject only to posted due dates.

### Guidelines for Completing and Submitting Coursework

Detailed instructions will be issued throughout the semester for graded coursework.