ENGG*3390 - Signal Processing

Fall 2024 Course Outline
Section: 02
Credits: 0.50

Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

Calendar Description

This course will establish the fundamental analysis and design techniques for signal processing systems. Topics covered include: definition and properties of linear time-invariant systems; impulse response and convolution; continuous-time Laplace transform, Fourier series, Fourier transform; discrete-time Fourier transform, discrete-time Fourier series, fast Fourier transform, Z transform; complex frequency response; filter analysis and design for both continuous and discrete time systems. Students will be able to design continuous-time filters and both design and implement discrete-time digital filters using computer-based tools.
Prerequisite(s): ENGG*2400
Restriction(s): This is a Priority Access Course. Enrolment may be restricted to the BME, CENG and ESC specializations in the BENG and BENG:C programs. See department for more information. Non-BENG students may take a maximum of 4.00 ENGG credits.
Department(s): School of Engineering

Lecture Schedule

TuTh 10am-11:20am in MCKN*120 (9/5 to 12/13)

Laboratory Schedule

Day	Time	Location	Sections
Friday	11:30 AM - 1:20 PM	THRN, Room 2307	101, 201
Thursday	8:30 AM - 10:20 AM	THRN, Room 2307	102
Thursday	12:30 PM - 2:20 PM	THRN, Room 2307	204
Wednesday	9:30 AM - 11:20 AM	THRN, Room 2307	103, 203

Instructor Information

Eranga Ukwatta
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Office: Richards 1507
Office Hours:
Thursdays from 3 pm to 4 pm. If this time does not work for you, please email to schedule individual appointments.
Office Phone: 519-824-4120 x53404

Sylvester Aboagye
Email: saboagye@uoguelph.ca
Office: THRN 2339
Office Hours:
Thursdays from 4 pm to 5 pm. If this time does not work for you, please email to schedule individual appointments.
Office Phone: 519-824-4120 x56248

Additional Support

Teaching Assistants

Teaching Assistant (GTA)	Email
Zachary Szentimrey	zszentim@uoguelph.ca
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Pranjani Suresh	psagar@uoguelph.ca
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Textbooks

Group	Title	Author	ISBN
Required	, Signals and Systems, 2nd edition, Wiley, 2004	Haykin, S., Van Veen, B.	
Recommended	Hwei P. Hsu	Schaum's Outline of Signals and Systems, McGraw-Hill, 1995	
Recommended	Monson H. Hayes	Schaum's Outline of Digital Signal Processing, McGraw-Hill, 1999	

Learning Resources

Required Resources

Course Website (Website) (http://courselink.uoguelph.ca)

Course material, news, announcements, and grades will be regularly posted to the ENGG*3390 Courselink site. You are responsible for checking the site regularly.

Course Resources

Bary Van Veen (Website)

http://AllSignalProcessing.com

Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor (https://www.uoguelph.ca/uaic/programcounsellors/) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the Learning Commons (https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

Course Learning Outcomes

1. Define the attributes of linear time-invariant systems and use convolution by the impulse response to calculate responses to arbitrary functions.
2. Identify the basic properties of signals and systems and identify what transforms and relationships apply to the various signals and system properties.
3. Define and apply the various continuous-time signal transforms, including: Laplace transform, Fourier series, Fourier transform.
4. Define and apply the various discrete-time signal transforms, including: discrete-time Fourier trans- form, discrete-time Fourier series, fast Fourier transform, Z transform.
5. Identify the relationships between the transforms, when they are and are not applicable to problems in signal processing systems design and analysis.
6. Design both electronic and digital filters to enhance signal quality; Enumerate the advantages and disadvantages of filter types; Evaluate their general frequency response, and design specific filters to meet performance requirements.
7. Apply the above transforms and design techniques to real systems and applications such as audio processing, communication systems, biological systems and biomedical systems.

Teaching and Learning Activities

Teaching and Learning Activities

Lecture

Week	Topics	Learning Outcome
1	Introduction	2
2	Signals and Systems	2
3	Laplace Review, Discrete Time	2, 3
4	Linear Time Invariant Systems	1, 2
5	Z Transform	4, 5
6	System Transfer Function, Convolution	1, 4, 5
7	Convolution cont., Properties of Impulse Response	5
8	Frequency Response, Filters (Active and Passive, IIR and FIR)	6
9	Filter Design, Fourier Representation: Continuous Time	3, 6
10	Fourier Representation: Discrete Time	3, 4, 5
11	Properties of Fourier Representation	3, 4, 5
12	Sampling and Quantization	5

Lab

Date	Topics	Learning Outcome
Wed, Sep 11 - Fri, Sep 13	Safety training, group formation and lab kit assignment	--
Wed, Sep 18 - Fri, Sep 20	Lab 1: Digital Signal Processing	2
Wed, Sep 25 - Fri, Sep 27	Lab 1: Follow-up Hour(s)	--
Wed, Oct 2 - Fri, Oct 4	Lab 2: Convolution	1, 7
Wed, Oct 9 - Fri, Oct 11	Lab 2: Follow-up Hour(s)	--
Wed, Oct 16 - Fri, Oct 18	Lab 3: Filtering and Frequency Response	2, 3, 4, 5
Wed, Oct 23 - Fri, Oct 25	Lab 3: Follow-up Hour(s)	--
Wed, Oct 30 - Fri, Nov 1	Lab 4: FIR and IIR Filter Design	6, 7
Wed, Nov 6 - Fri, Nov 8	Lab 4: Follow-up Hour(s)	--
Wed, Nov 13 - Fri, Nov 15	Lab 5: Frequency Domain Filtering	5, 6, 7
Wed, Nov 20 - Fri, Nov 22	Lab 5: Follow-up Hour(s)	--

Other Important Dates

Date	Event
Monday, October 14, 2024	Holiday -- No Classes Scheduled -- Classes rescheduled to Friday, November 29
Tuesday, October 15, 2024	Fall Study Break Day -- No Classes Scheduled -- Classes rescheduled to Thursday, November 28
Thursday, November 29, 2024	Make up for Study Day (Tuesday Schedule)
Friday, November 28, 2024	Make up for Holiday (Monday Schedule), Last day to drop F24 one semester courses

Assessment Breakdown

Marking Schemes & Distributions

Name	Scheme A (%)
Labs	25
Midterm Exam	25

Final Exam	50
Total	**100**

Assessment Details

Lab Reports

Labs — 25%

Five sabs will be held. See Lab Schedule for details. Reports for labs 1-4 are due before the start of the following lab.

The report for lab 5 is due at 5:30 pm 3 days after the lab.

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6, 7

Midterm

Midterm Exam — 25%

Date: Tue, Oct 22, In class

The midterm will be held during the class time.

Course Learning Outcomes Assessed: 1, 2, 3

Exam

Final Exam — 50%

See "Final Exam" Section below

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6, 7

Final Exam

Date: Dec 4

Time: Wed 7pm-9pm

Location: TBA *Please see Web Advisor closer to the date of scheduled final for location.*

To understand rules and regulations regarding Examinations students are encouraged to read Student's Responsibilities (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/examinations/)

If the student is unable to meet the final exam requirements due to medical, psychological or compassionate circumstances they are encouraged to review Student's Responsibilities in the Academic Consideration, Appeals and Petitions (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/) section of the Academic Calendar.

Last Day to Drop Course

The final day to drop Fall 2024 courses without academic penalty is the last day of classes: November 29

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

Course Grading Policies

Lab Work

You must complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration, the weight of the missed lab will be added to the final exam.

Late Lab Reports

Late submission of lab reports **will not** be accepted.

Assignment

Late submissions of assignment reports **will not** be accepted.

Passing Grade

As per University policy, the minimum **passing grade is 50%**

Course Standard Statements

Missed Assessments

If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration

Missed Midterm

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

If you miss a test due to grounds for granting academic consideration, the weight of the missed test will be added to the final exam.

School of Engineering Statements

Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on
Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible

Standard Statements for Undergraduate Courses

Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/) is outlined in the Undergraduate Calendar.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability. Use of the SAS Exam Centre requires students to make a booking at least 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (https://www.uoguelph.ca/sas/)

Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-accommodation-religious-obligations/).

Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all undergraduate students except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in the Undergraduate Calendar - Dropping Courses (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/).

Email Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (https://wellness.uoguelph.ca/). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (https://wellness.uoguelph.ca/navigators/) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources (https://wellness.uoguelph.ca/shine-this-year/). The Student Wellness team are here to help and welcome the opportunity to connect with you.

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

Recording of Materials

Presentations that are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars (http://www.uoguelph.ca/registrar/calendars/?index) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration. (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/)

Professional Accreditation Outcomes

Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

1. Knowledge Base

	Graduate Attribute Indicator	Instructional Level	Data Collection for Accreditation
1.1	Recall, describe and apply fundamental mathematical principles and concepts	Advanced	No
1.2	Recall, describe and apply fundamental principles and concepts in natural science	Advanced	Yes

2. Problem Analysis

	Graduate Attribute Indicator	Instructional Level	Data Collection for Accreditation
2.1	Formulate a problem statement in engineering and non-engineering terminology	Developed	Yes
2.2	Identify, organize and justify appropriate information, including assumptions	Developed	Yes
2.3	Construct a conceptual framework and select an appropriate solution approach	Developed	Yes
2.4	Execute an engineering solution	Advanced	Yes

4. Design

	Graduate Attribute Indicator	Instructional Level	Data Collection for Accreditation
4.1	Describe design process used to develop design solution	Developed	Yes