# ENGG*3390 Signal Processing

Fall 2018
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 05, 2018

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# 1 Course Details

## 1.1 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.

**Pre-Requisite(s):** ENGG*2400

## 1.2 Timetable

**Lectures:**

Group 1

| | | |
|---|---|---|
| Monday | 3:30 - 4:20 PM | LA 204 |
| Wednesday | 3:30 - 4:20 PM | LA 204 |
| Friday | 3:30 - 4:20 PM | LA 204 |

Group 2

| | | |
|---|---|---|
| Monday | 11:30 AM- 12:20 PM | THRN 1307 |
| Wednesday | 11:30 AM - 12:20 PM | THRN 1307 |
| Friday | 11:30 AM - 12:20 PM | THRN 1307 |

**Laboratory:**

| | | | |
|---|---|---|---|
| Wednesday | Sec 01 | 12:30 - 2:20 PM | THRN 2307 |
| Tuesday | Sec 02 | 8:30 - 10:20 AM | THRN 2307 |
| Thursday | Sec 03 | 8:30 - 10:20 AM | THRN 2307 |
| Friday | Sec 04 | 2:30 - 4:20 PM | THRN 2307 |

## 1.3 Final Exam

Saturday, December 8 at 11:30 A.M. to 13:30 P.M., Room: TBA

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# 2 Instructional Support

## 2.1 Instructor(s)

**Hadis Karimipour**
**Email:** hkarimi@uoguelph.ca
**Telephone:** +1-519-824-4120 x52506
**Office:** THRN 2409
**Office Hours:** TBA on Courselink or by appointment

## 2.2 Teaching Assistant(s)

**Teaching Assistant:** Jacob Sakhnini
**Email:** jsakhnin@uoguelph.ca
**Office Hours:** TBA on Courselink

**Teaching Assistant:** Carlos Sanchez Ramirez
**Email:** sanchezc@uoguelph.ca
**Office Hours:** TBA on Courselink

**Teaching Assistant:** Andrei Buin
**Email:** abuin@uoguelph.ca
**Office Hours:** TBA on Courselink

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# 3 Learning Resources

## 3.1 Required Resource(s)

**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.

**B.P. LATHI,R. Green, Linear System and Signals, 3rd edition, Oxford (Textbook)**

## 3.2 Recommended Resource(s)

**Monson H. Hayes, Schaum's Outline of Digital Signal Processing, McGraw-Hill, 1999 (Textbook)**
On Reserve

**Hwei P. Hsu, Schaum's Outline of Signals and Systems, McGraw-Hill, 1995 (Textbook)**
On Reserve

**Bary Van Veen (Website)**
http://AllSignalProcessing.com

**J. H. McClellan, R. W. Schafer, M. A. Yoder, Signal Processing First, Pearson, 2003. (Textbook)**
On Reserve

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# 4 Learning Outcomes

## 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

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

## 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

| # | Outcome Set Name | Course Learning Outcome |
|---|---|---|
| 1 | Knowledge Base | 1, 2 |
| 1.1 | Recall, describe and apply fundamental mathematical principles and concepts | 1, 2 |
| 1.2 | Recall, describe and apply fundamental principles and concepts in natural science | 2 |
| 2 | Problem Analysis | 1, 3, 4, 6, 7 |
| 2.1 | Formulate a problem statement in engineering and non-engineering terminology | 3, 4 |
| 2.2 | Identify, organize and justify appropriate information, including assumptions | 3, 7 |
| 2.3 | Construct a conceptual framework and select an appropriate solution approach | 7 |
| 2.4 | Execute an engineering solution | 1, 4, 6 |
| 4 | Design | 6 |

| # | Outcome Set Name | Course Learning Outcome |
|---|---|---|
| 4.1 | Describe design process used to develop design solution | 6 |

# 5 Teaching and Learning Activities

## 5.1 Lecture Schedule

| Week | Topics | Dates |
|---|---|---|
| | | · Sept. 3, Holiday |
| 3-7 Sept. | Introduction | · Sept.7, First Class |
| 10-14 Sept. | Signal & systems, Laplace Review | |
| 17-21 Sept. | Discrete-time Systems, Z Transform | · Sept. 17, Quiz 1 |
| 24-28 Sept. | Transfer Function, Convolution | |
| 1-5 Oct. | Impulse Response, Frequency Response | · Oct. 3, Quiz 2 |
| 8-12 Oct. | FIR  Design, Standard Filter Type | · Oct. 8, Holiday |
| 15-19 Oct. | FIR Filter | |
| 22-26 Oct. | IIR Filter | · Oct. 27, Midterm |
| 29 Oct.-2 Nov. | Continues-time LTI systems | |
| 5-9 Nov. | Fourier Rep., Disc.-time Fourier Series | |
| 12-16 Nov. | Cont.-time Fourier Series, Fourier Transform | · Nov.14, Quiz 3 |
| 19-23 Nov. | Properties of Fourier Representation | |
| 26 Nov. - 30 Nov. | Review | |
| 3-14 Dec. | Exam | |

***Disclaimer:***

The instructor reserve all right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph academic regulations.

## 5.2 Lab Schedule

| Week | Topic |
|---|---|
| 10-14 Sept. | Intr.to Lab Equipment -and Safety Training |
| 17-28 Sept. | DSP and Signals |
| 1-5 Oct. , 15-19 Oct. | Convolution |
| 22-25 Oct. | Midterm Exam Break (make-up Lab session ) |
| 29 Oct.- 2 Nov | Filtering and Frequency Response |
| 5-16 Nov. | FIR & IIR Filter Design |
| 19-23 Nov. | Frequency Domain Filtering |

## 5.3 Other Important Dates

**Monday October 8:** Thanksgiving Holiday

**Tuesday October 9:** Fall Study Break Day

**Friday, November 2:** Drop Date - 40th class

**Thursday, November 29, 2018:** Make up for Study Day (Tuesday Schedule)

**Friday, November 30, 2018:** Make up for Thanksgiving Day (Monday Schedule)

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# 6 Assessments

## 6.1 Marking Schemes & Distributions

| Name | Scheme A (%) |
|---|---|
| Quizzes | 9 |
| Labs | 25 |
| Midterm Exam | 26 |
| Final Exam | 40 |

| Name | Scheme A (%) |
|---|---|
| Total | 100 |

## 6.2 Assessment Details

**Quizzes & Assignments: (5%)**

Q1: Sept. 17, in class

Q2: Oct. 3, in class

Q3: Nov.14, in class

**Labs (20%)**

**Midterm Exam (25%)**
**Date:** , TBA
Saturday Oct 27 9:30-11:30 A.M.

**Final Exam (40%)**
**Due:** Sat, Dec 8, 11:30 AM - , 1:30 PM, TBA
TBA

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# 7 Course Statements

## 7.1 Course Grading Policies

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: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to re- ligious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Consideration of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Missed midterm: If you miss the midterm due to grounds for granting academic consideration or religious accommodation, the weight of the missed midterm will be added to the final exam weight. There will be no make-up midterm test.

Lab Work: You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a make-up lab.

Late Lab Reports: Late submissions of lab reports will not be accepted.  Lab reports are due one week after the lab session by 4:00 P.M..

Quizzes:  If academic consideration is granted for a missed quiz, the quiz weighting will be moved to the final exam weight.

Passing Grade: As per University policy, the minimum passing grade is 50%

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# 8 School of Engineering Statements

## 8.1 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.

## 8.2 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.

## 8.3 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.

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# 9 University Statements

## 9.1 Email Communication

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

## 9.2 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. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

## 9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

## 9.4 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.

## 9.5 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 book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

## 9.6 Academic Misconduct

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 is detailed in the Undergraduate Calendar.

## 9.7 Recording of Materials

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

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

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