Department of Electrical & Computer Engineering
Concordia University

ELEC 242: Continuous Time Signals and Systems

Winter 2017

Lectures: Tuesdays and Thursdays: 10:15 am – 11:30 am; Location: H435

Tutorials: Section WA: Tuesdays, 1:15 pm – 2:55 pm; Location: H533
Section WB: Fridays, 10:15 am – 11:55 am; Location: H937
Section WC: Fridays, 10:15 am – 11:55 am; Location: MB2.430
Section WD: Thursdays, 1:15 pm – 2:55 pm; Location: H513

Instructor: Dr. Rastko Selmic (rastko.selmic@concordia.ca)

Office Hours: Tuesdays and Thursdays: 1:00 pm – 2:00 pm; Location: EV5.209

Teaching Assist.: Omid Saatlou (o_saat@encs.concordia.ca)
Hamed Abdzadeh Ziabari (h_abdza@encs.concordia.ca)

URL: http://users.encs.concordia.ca/~rselmic/elec242

Description:
The course introduces continuous-time (analogue) signals and analysis and design of continuous-time systems. After reviewing some basic concepts in complex numbers, trigonometry, and functions, the course considers three alternate representations (differential equations, impulse response, and Laplace/Fourier transfer function) for linear, time invariant (LTI) systems. The analysis of LTI systems is covered for each of the three representations. Frequency-selective filters are introduced as a special class of LTI systems for which design techniques based on Butterworth filters are covered. Application of continuous-time system in communication systems is presented.

Topics:
- Continuous-time (CT) signals; Properties of continuous-time systems.
- Linear Time Invariant (LTI) systems; Impulse response; System analysis based on convolution and linear constant-coefficient differential equations.
- Fourier series representation of periodic signals; Fourier transform of aperiodic signals and systems; Inverse Fourier transform.
- Laplace Transform; Inverse Laplace Transform; Unilateral Laplace Transform; Natural and forced responses of linear differential equations.
- Time and frequency domain characteristics of ideal and non-ideal filters; Transfer function and block diagram representation of LTI systems.
- Design of CT filters.
- Amplitude modulation and demodulation.

Course Learning Objectives (CLOs):
Upon successful completion of the course, students will be able to:
1. Describe a CT physical process in terms of CT signals and systems and describe the properties of the CT systems.
2. Calculate the frequency representations of periodic and aperiodic CT signals.
3. Compute the steady state outputs of linear time-invariant systems by solving differential equations, by convolution, and by the Laplace/Fourier transform.
4. Design CT frequency selective filters based on the given system specifications.
5. Develop applications of CT systems in communications.

Prerequisites: ELEC 273, ENGR 213

Text: Mrinal Mandal and Amir Asif, *Continuous and Discrete Time Signals and Systems*, Cambridge University Press, New York. 2007. ISBN-13 978-0-521-85455-9. Information on this title: http://www.cambridge.org/9780521854559

Reference Books:
1. Michael J. Roberts, *Signals and Systems: Analysis Using Transform Methods and MATLAB*, 2nd edition, McGraw-Hill, New York, NY, 2004. ISBN # 978-0-07-338068-1.
2. B. P. Lathi, *Linear Systems and Signals*, 2nd edition, Oxford University Press, New York, NY, 2005. ISBN # 0-19-515833-4.
3. Simon Haykin and Barry Van Veen, *Signals and Systems*, John Wiley and Sons, Toronto, 1999. ISBN # 0-471-13280-7.
4. Samir S. Soliman and Mandyam D. Srinath, *Continuous and Discrete Signals and Systems*, Prentice Hall, New Jersey, 1998, ISBN # 0-13-518473-8.

Other Course Material:
Homework, suggested problems, and other required course material will be distributed either during the lectures in classroom or posted on the course website.

Tutorials:
In the scheduled tutorials, suggested problems will be solved and students' questions will be answered.

Grading Scheme:
Each student will be awarded a letter grade based on the following weighting of grades:
- Homework: 10%
- Quizzes based on homework: 15%
- Mid-term Exam: 30%
- Final Exam: 45%

The dates for the mid-term and final examinations will be announced in due course of time.

Homework:
Homework will provide hands on experiences related to the theoretical concepts covered in the class. Homework should be submitted before the start of the lectures. No late homework will be accepted.

Quizzes:
A short 15-minute quiz will follow homework submission to monitor students' learning. The quiz will be held in class prior to the lecture after the submission of the homework.

Course Schedule:
The following course schedule is subject to change based on the class performance.

Week	Topics	Comments
Week 1	Intro to Signals Sections 1.1	
Week 1	Intro to Signals Sections 1.2 – 1.3	
Week 2	Intro to Systems Sections 2.1 – 2.2	Homework #1 assigned
Week 2	Intro to Systems Sections 2.2 – 2.3	
Week 3	Time Domain Analysis of CT Systems Sections 3.1 – 3.3	Homework #1 due
Week 3	Convolution Integral and Impulse Response Sections 3.4 – 3.8	Quiz 1 Homework #2 assigned
Week 4	CT Fourier Series Sections 4.4 – 4.5	
Week 4	CT Fourier Series Sections 4.6 – 4.8	Homework #2 due
Week 5	CT Fourier Transform Sections 5.1 – 5.4	Quiz 2 Homework #3 assigned
Week 5	Properties of CT Fourier Transform Sections 5.5 – 5.6	
Week 6	Review	Homework #3 due
Week 6	**Mid term Exam**	
Week 7	Laplace Transform Sections 6.1 – 6.2	
Week 7	Inverse Laplace Transform Sections 6.3	Homework #4 assigned
Week 8	Laplace Transform Properties Section 6.4	
Week 8	Systems Analysis Using Laplace Transform Sections 6.5 – 6.7	Homework #4 due
Week 9	Stability Analysis Using Laplace Transform Sections 6.8 – 6.9	Quiz 3 Homework #5 assigned
Week 9	Block Diagram Representations Section 6.10	

Week 10	CT Filters Sections 7.1 – 7.2	Homework #5 due
Week 10	Design of CT Filters Section 7.3 – 7.4	Quiz 4 Homework #6 assigned
Week 11	Design of CT Filters Section 7.3 – 7.4	
Week 11	Amplitude Modulation Section 8.1	Homework #6 due
Week 12	Spring-Mass-Damper System Section 8.2	Homework #7 assigned
Week 12	Second-order Circuit Example	
Week 13	Course Review	Homework #7 due
Week 13	Course Review	
Final	**To be announced by the Registrar**	

Expectations of Originality Form:
The students are required to review, complete, and submit the Expectations of Originality form: https://www.concordia.ca/encs/students/sas/expectation-originality.html

Graduate Attributes:
The following graduate attributes will be assessed in this course.

Graduate Attributes	Indicator	Assessment Tool	CLOs
Knowledge Base For Engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.	Knowledge base of mathematics. Knowledge base in a specific domain.	Mid term Exam. Final Exam and quizzes.	1, 2, 3
Problem Analysis: An ability to use appropriate knowledge and skills to identify, analyze, and solve complex engineering problems in order to reach substantiated conclusions.	Problem identification and formulation. Modeling. Problem solving. Analysis.	Homework problems. Homework problems. Homework problems. Homework simulation problem.	4
Use of Engineering Tools: The ability to create, select, apply, adapt and extend appropriate techniques, resources and tools, to a range of engineering activities, from simple to complex, with an understanding of associated limitations.	Ability to use appropriate tools, techniques and resources. Ability to select appropriate tools, techniques and resources. Demonstrate awareness of limitations of tools and create and extend tools as necessary.	Use of MATLAB simulation tool in homework problems. Homework simulation problems. MATLAB simulation examples.	4, 5