ECE431H1F – Digital Signal Processing
General Information – Updated July 10, 2014

Description*:* An introductory course in digital filtering and applications. Introduction to real-world signal processing. Review of sampling and quantization of signals. Introduction to the discrete Fourier transform and its properties. The fast Fourier transform. Fourier analysis of signals using the discrete Fourier transform. Structures for discrete-time systems. Design and realization of digital filters: finite and infinite impulse response filters. DSP applications to communications: decimators and interpolators, estimation, equalization. DSP applications to multimedia: DCT and video coding.

Textbook:

- **Discrete-Time Signal Processing, 3/E, Alan V. Oppenheim, Ronald W. Schafer, Publisher: Prentice Hall, 2010, ISBN-10: 0131988425, ISBN-13: 9780131988422.**

Lecture Notes:

- **Instructor's notes; posted online (ECE431 – UofT portal).**

Week	Lecture	Date (month/day)	Topics	Posted notes/ Book Section(s)
1	1	09/05	Introduction to Course, ECE216 review lecture	Lecture-1-2014.pdf ECE216-Review.pdf
	2	09/08	Sampling of continuous time signals	Lecture-2-2014.pdf Sections 4.1, 4.2, 4.3
	3	09/10	Discrete time signals & Systems	Lecture-3-2014.pdf Sections 2.1, 2.2
2	1	09/12	Linear time invariant (LTI) systems	Lecture-4-2014.pdf Sections 2.3, 2.4, 2.5
	2	09/15	Discrete time Fourier transform	Lecture-5-2014.pdf Sections 2.6, 2.7
	3	09/17	Discrete time processing of continuous time signals	Lecture-6-2014.pdf Sections 4.3, 4.4
3	1	09/19	The Z-transform, properties of the Z-transform	Lecture-7-2014.pdf Sections 3.1, 3.2
	2	09/22	The inverse Z-transform, properties of the Z-transform	Lecture-8-2014.pdf Sections 3.2, 3.3
	3	09/24	Transform analysis of LTI systems	Lecture-9-2014.pdf Sections 3.5, 3.6
4	1	09/26	Frequency response of rational systems	Lecture-10-2014.pdf Sections 5.1, 5.2, 5.4
	2	09/29	Relation between magnitude & phase	Lecture-11-2014.pdf Sections 5.4, 5.5
	3	10/01	Minimum phase systems	Lecture-12-2014.pdf Section 5.6
5	1	10/03	Generalized linear phase	Lecture-13-2014.pdf Section 5.7

	2	10/06	Sampling, Phase, LTI Systems	Recitation Lecture Problems-Matlab-set1-2014.pdf Problems-Matlab-set2-2014.pdf Problems-Matlab-set3-2014.pdf
	3	10/08	Frequency response & Z-transform	Recitation Lecture Problems-Matlab-set5-2014.pdf Problems-Matlab-set6-2014.pdf
6	1	10/10	Structures of discrete time systems: I	Lecture-14-2014.pdf Sections 6.1, 6.2
	2	10/15	Structures of discrete time systems: II	Lecture-15-2014.pdf Sections 6.3, 6.4
	3	10/17	Structures of discrete time systems: III	Lecture-16-2014.pdf Section 6.5
7	1	10/20	The discrete Fourier Series	Lecture-17-2014.pdf Sections 8.1, 8.2
	2	10/22	Discrete Fourier transform (DFT)	Lecture-18-2014.pdf Sections 8.3, 8.4, 8.5, 8.6
	3	10/24	Fast Fourier transform (FFT)	Lecture-19-2014.pdf Sections 9.1,9.2,9.3
8	1	10/27	DFT & circular convolution	Recitation lecture Problems-Matlab-set4.pdf Midterm preparation
	2	10/29	DFT	Recitation lecture Midterm preparation
	3	10/31	FFT	Recitation lecture Midterm preparation
9	1	11/03	Midterm Test	
	2	11/05	Continuous time IIR filters from continuous time filters	Lecture-20-2014.pdf Section 7.2
	3	11/07	Discrete time filter design by windowning	Lecture-21-2014.pdf Sections 7.5, 7.6
10	1	11/10	IIR filter design review	Recitation lecture
	2	11/12	Optimum approximation of FIR filters	Lecture-22-2014.pdf Section 7.7
	3	11/14	Filter design review	Recitation lecture
11	1	11/17	Changing the sampling rate	Lecture-23-2014.pdf Section 4.6
	2	11/19	A/D & D/A converters	Lecture-24-2014.pdf Section 4.8

	3	**11/21**	**Finite precision numerical effects**	**Lecture-25-2014.pdf Section 6.8**
12	**1**	**11/24**	**Adaptive filters**	**Lecture-26-2014.pdf**
	2	**11/26**	**Discrete cosine transform & JPEG**	**Lecture-27-2014.pdf**
	3	**11/28**	**Image data formats & color images**	**Lecture-28-2014.pdf**
13	**1**	**12/01**	**Review: sampling & LTI**	
	2	**12/03**	**Review: DFT & FFT**	

NOTE: This outline is provided for information purposes only. All specific details are subject to change.

Instructor & Course Coordinator:

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Office Hours: Monday 13.00 pm – 2.00 pm, Wednesday 13.00 pm – 14.00 pm or by appointment.

ECE431 Fall 2014 Timetable:

Course No	Session	Starting Date	No	Date	Start Time	End Time	Room	Instructor	Other
ECE431H1F	LEC0101	2014/09/04	1	Mon	12:00	13:00	GB244	Plataniotis, Konstantinos	
ECE431H1F	LEC0101	2014/09/04	1	Fri	14:00	15:00	GB244	Plataniotis, Konstantinos	
ECE431H1F	LEC0101	2014/09/04	1	Wed	12:00	13:00	GB244	Plataniotis, Konstantinos	
ECE431H1F	PRA0101	2014/09/04	2	Tue	09:00	12:00	SF2201	Laboratory	occurs once every two weeks
ECE431H1F	PRA0102	2014/09/08	2	Tue	09:00	12:00	SF2201	Laboratory	occurs once every two weeks
ECE431H1F	PRA0103	2014/09/04	2	Tue	15:00	18:00	SF2201	Laboratory	occurs once every two weeks
ECE431H1F	TUT0101	2014/09/04	1	Thu	13:00	14:00	HA401	Tutorial	
ECE431H1F	TUT0102	2014/09/04	1	Thu	13:00	14:00	BA2155	Tutorial	

Composition of the final mark:

Final Examination	40%
Midterm Test	20%
Quizzes	20%
Laboratory assignments	20%

Midterm Test: It will take place during lecturing time on: **Monday, November 3, 2014 at 12.00 noon, room GB 244**

All examinations (quizzes, midterm tests, and final exam) are closed book. A two-sided aid sheet is permitted (Type C Examination). A type 2 calculator may be used.

Laboratories: Laboratory assignments are an important part of the ECE431 offering. Laboratory problems are self-contained, offer coverage of fundamental theory and DSP applications and are designed to help students to develop a stronger intuition and a deeper understanding of the material covered in class. Problems demand initiatives from students, involve processing real-data, and often require (some) open-ended work. Laboratory handouts will provide detailed instructions for students and they will guide them through the topics explored.

Laboratory Link: www.comm.utoronto.ca/~bkf/ECE431

Homework: ECE431 is one of the most interesting and useful courses in your curriculum. Digital signal processing is an exceptional toolset for electrical and computer engineers. DSP impacts all modern aspects of life and sciences; from communication systems, to consumer electronics, to entertainment to health, and economics. However, it is also one of the most challenging upper-year courses while a lot of emphasis on analysis and design. To do well in ECE431 students should keep up-to-date with the class schedule, and practice through homework and other exercise problems. Homework problems will be announced weekly. Homework problems will not be collected, but you required to work out the assigned problems before new material is covered.

Tutorials: In ECE431 tutorials begin on the 2nd full week of classes. In tutorial sessions the teaching assistants will cover (some) homework exercise problems, take questions from students and present extended examples from DSP theory and practice. Moreover, there will be one 10 minutes quiz in each tutorial. There will be no quizzes on the week of Monday, November 3, 2014 and on the week of Monday November 24. The purpose of these quizzes is to help students keep up with the class material, thus they are designed to be rather easy. The lowest four (4) quiz marks will be automatically dropped from your course grade calculations in order to account for illness, scheduling conflicts and personal/attendance problems. **Other than that, no exception for missing quizzes will be given. You are required to attend the tutorial /quiz section registered on ROSI.**

Course Website: The course website is at the University of Toronto portal. Lecture notes, supporting documentation, handouts, homework problems, announcements, and grades will be posted on the web page. Students are required to check it regularly for new information

ECE431H1F 2014 Tutorial Homework Assignment

(Last updated: July 10, 2014)

Assignment #1:
2.11, 2.28, 2.29, 2.49, 2.53, 4.4, 4.10, 4.11
(Discussed in tutorial week of September 15)

Assignment #2:
2.13, 2.16, 2.30, 2.34, 2.47
(Discussed in tutorial week of September 22)

Assignment #3:
3.12, 3.16, 3.22, 3.23, 3.25, 3.45, 3.46
(Discussed in tutorial week of September 29)

Assignment #4:
5.2, 5.7, 5.10. 5.11, 5.23, 5.38
(Discussed in tutorial week of October 6)

Assignment #5:
3.47, 5.22, 5.24, 5.42, 5.43
(Discussed in tutorial week of October 13)

Assignment #6:
6.5, 6.6, 6.7, 6.10, 6.24, 6.26, 6.29, 6.31, 6.32
(Discussed in tutorial week of October 21)

Assignment #7:
8.5, 8.12, 8.17, 8.23, 8.28a-d, 8.52
(Discussed in tutorial week of October 27)

Assignment #8:
9.6, 9.7, 9.11, 9.21, 9.29
(Discussed in tutorial week of November 3)

Assignment #9:
7.2, 7.3, 7.7, 7.17, 7.18, 7.23
(Discussed in tutorial week of November 10)

Assignment #10:
7.6, 7.16, 7.22, 7.24
(Discussed in tutorial week of November 17)

Assignment #11:
4.26, 4.27, 4.31, 4.32, 4.37
(Discussed in tutorial week of November 24)

Note:

- **All problems** from Alan V. Oppenheim, Ronald W Schafer, **Discrete-Time Signal Processing**, 3rd Edition, Prentice Hall, ISBN 978-0-13-198842-2, 2010.
- Homework problems will not be collected, but you are required to work out the problems before new materials are covered.