ECSE 512 – Digital Signal Processing 1

Fall 2010

1 Information

Lectures	MW	4:05-5:25 pm	ENGTR 2120
Tutorials	W	5:35-6:55 pm	ENGTR 2110

Instructor	Mai Vu mai.h.vu@mcgill.ca 514-398-8940 McConnell 529 OH: F 2-3pm or by appointment
TA	Qunbi Zhuge qunbi.zhuge@mail.mcgill.ca 514-398-8053 McConnell 848 OH: TBA

2 Prerequisites

- ECSE 304 Signals and Systems 2, or equivalence.
- ECSE 305 Probability and Random Signal 1, or equivalence.
- This course is NOT open to students who have taken an undergraduate course in digital signal processing (equivalence to ECSE 412 Discrete-Time Signal Processing).

3 Assessment

- 10% homework
- 30% midterm exam
- 20% project
- 40% final exam

We reserve the right to alter these percentages based on the performance of the entire class.

- Exams: The midterm exam is in-class. The final will be a 3-hour exam administered according to the University's calendar.
- Homework: The homework are bi-weekly with both analysis problems and Matlab exercises. Homework sets are due in class. For late homework without prior arrangement, we will deduct 10% for each late day and not accept after 3 late days.
- Project: The goal is to provide you with an experience in integrating the theory and building a simple yet practical system. The project will be approximately 2-3 weeks, given toward the end of the semester.

4 Text and References

Textbook

Oppenheim and Schafer, *Discrete-time Signal Processing*, 3rd ed., Prentice-Hall, 2010.

Recommended references

1. Proakis and Manolakis, *Digital Signal Processing*, 4th ed., Pearson, 2007.
2. D. Hanselman and B. Littlefield, *Mastering MATLAB 6: A comprehensive tutorial and reference*, Prentice-Hall, 2001.

5 Course Description

ECSE512 is a first-year graduate level class on digital signal processing. The course focuses on theoretical concepts, analysis methods and algorithms, while also exposing students to application and implementation issues through various examples and assignments. At the end of this course, students should be able to understand the basic principles and apply fundamental algorithms and methods to analyze and design discrete-time systems for modern DSP applications.

6 Syllabus

1. Review of signals and systems: linear time-invariant (LTI) systems, convolution sum, finite (FIR) and infinite (IIR) impulse responses, difference equations.
2. Transform analysis of LTI systems: The Z transform, pole-zero representation for rational systems, all-pass system, inverse system and minimum-phase system, generalized linear phase property.
3. Sampling: The sampling theorem, reconstruction formula, quantization, sampling rate conversion, ADC and DAC, oversampling and noise shaping.
4. Discrete Fourier Transform (DFT), trade-off between temporal and frequency resolutions. Computation of the DFT, FFT algorithms.

5. Structure for discrete-time systems: signal flow graph representation, FIR and IIR systems, effects of coefficient quantization and round-off noise.

6. Filter design: Filter specifications, discrete-time IIR filter design, FIR filter design: windowing, frequency sampling, linear-phase FIR filters.

7. Multirate signal processing: Sample-rate conversion, polyphase systems, subband filtering and filter banks.

8. Linear prediction and adaptive filters (as time permits).

7 Format

This course will have 24-26 lectures covering around 13 weeks. Each lecture is for 80 minute. In addition, students will need to show a project demo at the end of the term.

Course website *http://www.info512.ece.mcgill.ca*.