Electrical and Computer Engineering Course Syllabus

Instructor:	Prof. Henry Pfister	**E-mail:**	henry.pfister@duke.edu
Office / Hour:	305 Gross Hall / Tu 1:30 - 2:30 PM	**Phone:**	(919) 660-5288
Class Room:	Hudson Hall 216	**Class Time:**	MW 1:25 - 2:40 PM

Course Name:	**ECE 485**
Course Title:	**Digital Audio Processing**
Prerequisite(s):	ECE 280 - Signals and Systems
Required Text(s):	Course reader handouts
Other Text(s):	*Discrete-Time Signal Processing* by Oppenheim and Schafer, 3rd Ed. (DTSP-3)
	Principles of Digital Audio by Ken Pohlmann (PDA)
	Digital Signal Processing by Proakis and Manolakis, 4th Ed. (DSP-4)
	Signals and Systems by Oppenheim, Willsky, and Hamid, 2nd Ed. (SSOW)

Course Objectives:

Digital audio signal processing (DASP) consists of the recording, storing, manipulation, transmission, and reproduction of high quality acoustic signals such as music. DASP is an extremely broad field spanning acoustics, hearing, signal processing, communications, music, and psychoacoustics. This course focuses on fundamental signal processing aspects of DASP. This course covers may of the principles behind commercial digital audio workstation (DAW) tools. However, it is **not** a course on how to use commercial software such as Pro Tools or Logic Studio.

At the end of the course, the student should be able to:

1. Describe basic elements of discrete-time signal processing including the discrete-time Fourier transform, the Z-transform, and discrete-time linear filtering.
2. Understand practical details of A/D and D/A conversion including quantization noise, dither, oversampling, and sigma-delta converters.
3. Implement sample rate conversion for audio processing and music synthesis.
4. Understand basic acoustics and implement digital reverberation and other effects.
5. Understand time-frequency analysis for audio applications including filter banks and the modified discrete-cosine transform.
6. Implement time and pitch scale modification of audio signals.
7. Understand perceptual models of human hearing and implement a simple form of perceptual-based audio coding.
8. Capture and process the spatial dimension of sound with microphone arrays.

Student Evaluation:

Midterm	20%	Homework	25%
Final	25%	Projects	30%

- Homework will include short MATLAB tasks. Projects will have longer MATLAB tasks.

Rules and Guidelines:

The class shall follow all established policies of Duke University.

Course Topics and Hours: (2.5 hours/week)

Unit	Topics	Hours
1	Review of Discrete-Time Signal Processing	6.25
2	Waveform and Physical Synthesis	5
3	Autocorrelation and Pitch Detection	2.5
4	Digital Effects Processing	3.75
5	Sampling, Quantization, and Dither	5
6	Perceptual Models of Hearing and Audio Coding	2.5
7	Array Processing of Audio Signals	5
8	Filter Banks and the Phase Vocoder	5
	Total Hours	35

Tentative Schedule:

Week	Date	Monday	Wednesday	Notes
0	1/9	X	1	
1	1/16	X	2	MLK Holiday
2	1/23	3	4	
3	1/30	5	6	
4	2/6	7	8	
5	2/13	9	10	Guest
6	2/20	11	12	
7	2/27	13	14	
8	3/6	15	16	Midterm Monday
9	3/13	X	X	Spring Break
10	3/20	17	18	
11	3/27	19	20	Friday Last Withdrawl
12	3/30	21	22	
13	4/3	23	23	
14	4/10	25	26	
15	4/17	27	28	
16	4/24	29	30	

Final Exam: Friday, May 5th, 9:00 AM - 12:00 PM