ECE 5200: Introduction to Digital Signal Processing

Course Description

Sampling and reconstruction; discrete-time rate conversion; processing of discrete-time signals; design of discrete-time filters, selected topics in adaptive and/or multidimensional signal processing.

Prior Course Number: 600, 801.01
Transcript Abbreviation: Intro Dig Sig Proc
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Junior, Senior, Masters, Doctoral
Course Offerings: Autumn, Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 3050, and Stat 3470 or Math 530; or Grad standing.
Exclusions: Not open to students with credit for 600 or 801.01.
Cross-Listings:

Course Rationale: Existing course.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Master undergrad-level signals & systems concepts (e.g., linearity, time-invariance, causality, stability, impulse response, convolution, Fourier series, CTFT, DTFT, Laplace transform, Z-transform), applying these concepts to new problems
Master the fundamentals of sampling and reconstruction, i.e., conversion between the continuous-time and discrete-time domains, as well as discrete-time rate conversion (e.g., upsampling, downsampling, interpolation, decimation)
Master filter design based on magnitude response and phase response; FIR filter design methods like window-based, weighted least-squares, & equiripple designs; IIR filter design methods based on bilinear transform & least-squares

Be competent with the fundamental concepts in the processing of finite-duration discrete-time signals, including windowing, DFT, circular convolution, spectral analysis, FFT, fast convolution, and overlap/save processing
Be familiar with selected topics in multidimensional, multirate, and/or adaptive signal processing
Be competent with programming discrete-time signal processing and analysis tasks in Matlab, Python, or similar high-level languages

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Signals and systems review: system properties (e.g., linearity, time invariance, causality, stability), impulse response, convolution, Fourier series, CTFT, Laplace transform, DTFT, Z-transform	6.0							
Sampling and conversion: sampling, aliasing, Nyquist rate, sinc reconstruction, ZOH reconstruction, upsampling, downsampling, interpolation, decimation, rate conversion	6.0							
Processing of finite-length discrete-time signals: DFT, circular convolution, windowing, spectral analysis, matrix/vector formulations, FFT, fast convolution, overlap-save	6.0							
Design of discrete-time filters: ideal magnitude responses, group delay, linear phase, FIR designs (e.g., window-based, frequency-sampled, weighted least-squares, equiripple), IIR designs (e.g., bilinear transform, Prony's method, Shank's method).	8.0							
Selected topics in multidimensional and/or adaptive signal processing	12.0							

Representative Assignments

Weekly homework problems with both analytical and Matlab content will be assigned.

Grades

Aspect	Percent
Homework	30%
Two midterm exams	40%
Final exam	30%

Representative Textbooks and Other Course Materials

Title	Author
Discrete-Time Signal Processing	Oppenheim and Schafer

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
**	c	An ability to design a system, component, or process to meet desired needs.

Course Contribution		College Outcome
	d	An ability to function on multi-disciplinary teams.
**	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
**	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
***	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Additional Notes or Comments

Update prereq, exclusion, goals and topics to match university format.

DEleted text Digital Signal Processing (3rd Ed.), McGraw-Hill 2006 by Mitra.

Added MATH 530 to prereqs. Note that MAath 530 is acceptable but the semester version is NOT. 5/7/12

Added srping offering (to be offeredboth semesters now) March 15, 2013.

Changed AEBT-EAC criteion 3c from significant to substation contribution. April 29,. 2014 BLA

edited text info, 5/10/17, CED

Rewroded goals, adjust to grading, new ABET outcomes 6/5/2019 BLA

remove quarter courses from prereqs to match registrar 9/3/19

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