ECE 343: Signals & Systems (4 Credits)
Spring 2012 Course Information and Policies

Instructor	Dr. Roger A. Green, *Roger.Green@ndsu.edu* ECE 215B, 231-1024 (office), 293-7847 (home)
Office Hours	11:00–11:50 am MWF or by appointment.
Description	Discrete-time and continuous-time signals and systems. Linearity, frequency response, difference and differential equations, transform techniques. Course covers a variety of essential mathematical concepts including complex arithmetic, series representations, difference and differential equations, convolution, Laplace transforms, z-transforms, and various Fourier representations.
Prerequisites	ECE 311, Circuit Analysis II. Familiarity with MATLAB is expected.
Primary Text	B. P. Lathi, *Linear Systems and Signals,* 2nd Ed., Oxford University Press, 2005. The course will cover chapters B, 1, 2, 3, 4, 5, selected portions of chapters 6 and 7, and, time permitting, portions of chapters 8 and 9.
Supplemental Texts	• Oppenheim and Willsky, *Signals & Systems,* 2nd Ed., Prentice Hall, 1997. • Haykin and Van Veen, *Signals and Systems,* 2nd Ed., John Wiley & Sons, Inc., 2003.
Lectures	MWF 3:00–3:50 ECE 125, T 3:30–4:20 ECE 243. Lecture material is derived from a variety of sources including the class text, supplemental texts, personal notes, etc. Attendance is expected.
Grading	36% Pretest, quizzes, and homework: daily 12% Exam #1: Fri., Feb. 3 12% Exam #2: Mon., Feb. 27 12% Exam #3: Mon., March 26 12% Exam #4: Wed., April 18 16% Comprehensive final exam: Mon., May 7, 10:30–12:30 Thresholds: 90–100 = A; $80–90^-$ = B; $70–80^-$ = C; $60–70^-$ = D; <60 = F Grade thresholds may be lowered at the discretion of the instructor.
Homework	Homework is due at the beginning of class on the due date. Neatly present homework solutions on engineering paper with no more than one problem per page. Put your name on each page. Do not fold your homework. A random selection of problems will be collected and graded. Late, illegible, or improperly formatted homework will not be given credit.
Exams and Quizzes	While exams will emphasize class material and homework, students are expected to apply concepts and techniques to new situations. All exams and quizzes are closed book and closed notes. No calculators or crib sheets are permitted on exams or quizzes.
Academic Honesty	All work in this course must be completed in a manner consistent with the CEA Honor Code (*http://www.ndsu.nodak.edu/ndsu/cea/*) and NDSU Policy 335: Code of Academic Responsibility and Conduct (*http://www.ndsu.nodak.edu/policy/335.htm*). Any use of solutions manuals is strictly prohibited and grounds for failing the course.
Special Needs	Students with disabilities or special needs who need special accommodations should share their concerns or requests with the instructor as soon as possible.

Session	Topic
1	Complex numbers and properties, complex exponentials
2	Taylor/Maclaurin series, complex roots, logarithms, frequency
3	Rational functions and partial fraction expansions
4	Vectors/matrices, Cramer's rule, CT power and energy
5	Signals & classifications, operations on dependent and independent variables
6	CT functions: unit step and Dirac delta functions; symmetry decompositions
7	CT system properties (linearity, time-invariance)
8	CT properties (realness, causality, memorylessness, internal/external, stability)
9	Operator notation, CC linear differential equations, CT characteristic equations, eigenfunctions
10	CT system response: zero-input response
11	CT system response: impulse response function
12	CT system response: zero-state response and convolution
13	CT convolution properties
14	CT system stability, describing system behavior
15	Discrete time (DT) energy and power, DT signal operations
16	Useful DT functions: unit step and Kronecker delta functions
17	DT system properties (linearity, time-invariance, realness, causality, memorylessness)
18	Operator notation, CC linear difference equations, DT characteristic equations, eigenfunctions
19	DT system response: zero-input response
20	DT system response: impulse response function
21	DT system response: zero-state response and convolution
22	DT convolution properties, stability, describing DT system behavior
23	The Laplace transform and its inverse
24	Unilateral Laplace transform, properties, initial and final value theorems
25	Solving differential equations, transfer function
26	Transform domain analysis of circuits
27	CT block diagrams, parallel and series implementations
28	CT system realizations (DFI, DFII, TDFI, TDFII)
29	CT frequency response, Bode approximations
30	Bilateral Laplace transforms, region of convergence
31	The z-transform and its inverse (including power series expansion techniques)
32	z-transform properties, initial and final value theorems
33	Unilateral z-transforms and solving difference equations
34	DT transfer function and transform domain system properties
35	DT block diagrams (DFI, DFII, TDFI, TDFII, parallel, series realizations)
36	DT frequency response
37	Bilateral z-transform, region of convergence
38	Periodic CT signals, Fourier series (FS), LTIC system response to periodic inputs
39	Linear vector spaces and the orthogonality principle
40	Complex Fourier series derived by orthogonality, convergence, Dirichlet conditions
41	FS pairs and properties, symmetry conditions, Gibbs phenomenon, analysis and synthesis
42	Aperiodic CT signal analysis using the Fourier transform (FT)
43	Convergence, Dirichlet conditions, FT pairs and properties
44	LTIC system analysis using FT, filtering concepts, CT window functions
45	Sampling theorem, discrete-time Fourier series (DTFS), discrete-time Fourier transform (DTFT)

ECE 343 Course Objectives:

Upon successful completion of the course, students will be able to...

(1) Mathematically represent continuous-time and discrete-time signals and determine signal properties.

(2) Mathematically represent continuous-time and discrete-time systems using constant coefficient linear differential and difference equations and determine system properties.

(3) Use time-domain techniques to determine the zero-input and zero-state responses of continuous-time and discrete-time systems, which includes determination of a system's impulse response and computation of the convolution integral/sum.

(4) Perform transform-domain analysis of continuous-time signals and systems using the direct and inverse unilateral and bilateral Laplace transforms and properties.

(5) Perform transform-domain analysis of discrete-time signals and systems using the direct and inverse unilateral and bilateral z-transforms and properties.

(6) Generate block-diagram and circuit realizations of differential and difference equations and vice-versa.

(7) Determine the transfer function and frequency response of continuous-time and discrete-time systems and use this information to assess system behavior and properties.

(8) Perform frequency-domain analysis of continuous-time signals and systems using the Fourier series, the Fourier transform, and their properties.

(9) Use modern computer-aided design and analysis tools such as MATLAB to solve signals and systems problems.

Relation of Course Objectives to ABET Criterion 3 Student Outcomes

	ABET Criterion 3 Student Outcomes	Course Objectives
(a)	an ability to apply knowledge of mathematics, science, and engineering	(1, 2, 3, 4, 5, 6, 7, 8)
(b)	an ability to design and conduct experiments, as well as to analyze and interpret data	(1, 3)
(c)	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	(6, 7)
(d)	an ability to function on multidisciplinary teams	
(e)	an ability to identify, formulate, and solve engineering problems	(1, 2, 3, 4, 5, 6, 7, 8)
(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, economic, environmental, 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	(9)
(l)	an ability to grow in the knowledge of and make professional contributions to at least one specific area of ECE	