ECE 3204 (335) – SIGNALS AND SYSTEMS

Course Syllabus, Session 2, Winter 2018

2017-18 Catalog Data: ECE 3204: Signals and Systems (4 credits)

Basic signals, average value, average power, and energy. Laplace transform and inverse Laplace transform, and transfer function concept and approach in the analysis of electrical and mechanical lumped-parameter linear systems. Systems modeling and analysis in Laplace and differential equation domains. Natural and forced responses of linear time-invariant systems, and concept of convolution. Fourier analysis of signals and systems: Fourier series and Fourier transform, power spectral density, energy spectral density, band width, and filters.

Textbook: B.P. Lathi, *Linear Systems and Signals*, 2nd Edition, Oxford University Press, New York, Oxford, 2005. ISBN-13 978-0-19-515833-5.

Instructor: Edward Gu, Professor of ECE, *guy@oakland.edu*, 334 EC, (248) 370-2219.

Prerequisite: ECE 2005 (276) and Major Standing

ABET/Outcomes: Provide the students with

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 within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
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, 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.

Course Objectives: Upon successful completion of ECE 3204, the students will

(1) Be able to use Laplace transformation and inverse Laplace transformation to solve signal and system problems, such as the partial fraction expansion (residue) method combined with Matlab; (a,b,e,k)
(2) Be able to write and solve the dynamic equations for simple electrical and mechanical systems; (a,e,k)
(3) Be able to use transfer functions to model and analyze dynamic systems; (a,e,k)
(4) Be able to model systems using state-space techniques, such as the controllable and observable canonical forms; (a,e,k)

(5) Be able to understand the concepts and properties of Fourier series and Fourier transformation; (a,e,k)
(6) Be able to analyze and design simple filters, and sketch their characteristics; (a,e,k)
(7) Be able to use Matlab to solve problems and simulate system responses with Matlab - Matlab helps and enhances our learning process; (a,b,e,k)
(8) Be able to use knowledge of mathematics, science, and engineering to analyze signals, systems, and their characteristics. (a,e,k)

Class Schedule: 1:00 - 2:47pm every Tuesday and Thursday at 187 MSB

Grading System: Homework - 8 %, Attendance - 8 %,
Exam #1 - 28 % (Early February),
Exam #2 - 28 % (Mid of March), Final Exam - 28 %

Class Policy:

1. No late homework due is acceptable;
2. No late make-up examination will be offered;
3. Each exam: open-book, open notes, and no wireless device is allowed;
4. A better class attendance will earn up to 8 points.

Major Topics:

Chapter B - Mathematical Background and Reviews

Chapter 1 - Representations of Signals and Systems (Ch. 1)

1. Types of Signals and Signal Representations
2. Systems Modeling and Classification

Chapter 2 - Continuous-Time (CT) and Discrete-Time (DT) Systems (Ch. 2, 3)

1. Introduction to CT Systems Modeling
2. System Response to Internal Conditions
3. System Response to External Inputs
4. Systems Stability
5. DT Systems Modeling and Responses
6. Applications

Chapter 3 - Laplace Transformation (Ch. 4, 5)

1. Mathematical Definition of Laplace Transformation
2. Properties of Laplace Transformation
3. Block Diagrams and Transfer Functions
4. Poles, Zeros and System Stability
5. *z*-Transformations for DT Systems: Modeling and Analysis

Chapter 4 - Applications of Laplace Transformation (Ch. 4, 5)

1. Electrical and Op-Amp Circuit Analyses
2. Mechanical Systems
3. Electromechanical Systems

Chapter 5 - Fourier Analysis (Ch. 6, 7)

1. Fourier Series (FS): Analysis and Computations
2. Power, Energy and Parseval's Theorem
3. Fourier Transformation (FT) and Representations

Chapter 6 - Applications of Fourier Transformation (Ch. 6, 7)

1. Passive and Active Filters
2. Signal Spectrum Analysis
3. Signal Energy
4. Amplitude Modulation (AM)
5. Data Truncation: Window Functions

Chapter 7 - Sampling and Discrete-Time Fourier Analysis (Ch. 8, 9)

1. Sampling Theorem and Signal Reconstruction
2. Temporal and Spectral Samplings and Their Dual Relationship
3. DTFS, DTFT, FFT and Their Applications

Chapter 8 - Systems State-Space Representation (Ch. 10)

1. State-Space Models and Representations
2. General Solutions to State-Space Equations
3. Physical Insights and Applications