ECE 513 - DIGITAL SIGNAL PROCESSING
Fall 2015
Course Syllabus

Class Schedule: TTh 12:50 to 2:05, Room 1230, Engineering Building II

Instructor: Dr. Cranos M. Williams
Associate Professor, ECE
Office - 2110 Engineering Building II (EBII)
Office Phone - (919) 513-1923
On Campus Office Hours - T 2:30-3:30pm, Th 2:30-3:30pm
Distance Education Office Hours - T 3:30-5pm, or by appointment
Email - cmwilli5@ncsu.edu

PREREQUISITES

The prerequisites for this course are as follows:

1. An introductory level course in digital signal processing (ECE 421)
2. B average in ECE and Mathematics

Prerequisites by topic include:

1. Concepts for the processing of continuous–time signals,
   (a) convolution (continuous–time and discrete–time).
   (b) sampling of continuous–time signal
   (c) correlation analysis
   (d) amplitude modulation
2. Fourier series,
3. Fourier transform,
4. Z-transform,
COURSE DESCRIPTION

ECE 513 Digital Signal Processing 3(3-0-0) F
Preq: ECE 421, B average in ECE and MA or Consent of Instructor
Digital processing of analog signals. Offline and real-time processing
for spectrum estimation, filter design, and multirate signal processing.
Analysis of FIR and IIR filter structures for efficient implementation.
Advanced topics include design of quadrature mirror filter banks and
discrete wavelet transforms.

The following subjects are covered:

1. Review of Fundamental DSP Concepts
   (a) Discrete–Time Signals and Systems
   (b) Z–Transform and its Applications to the Analysis of LTI Sys-
        tems
   (c) Frequency Analysis of Signals
   (d) Frequency Domain Analysis of LTI Systems

2. Sampling and Reconstruction of Signals
   (a) Ideal Sampling and Reconstruction
   (b) Sampling of Bandpass Signals

3. The Discrete–Time Fourier Transform: Its Properties and Appli-
   cations
   (a) The Discrete Fourier Transform
   (b) Filtering Long Sequences
   (c) DFT Spectral Estimation
   (d) The Discrete Cosine Transform

4. Implementation of Discrete–Time Systems
   (a) FIR Filter Structures
   (b) IIR Filter Structures
5. Design of Digital Filters
   (a) FIR Filter Design
   (b) IIR Filter Design

6. Multirate Digital Signal Processing
   (a) Interpolation and Decimation
      i. Frequency Interpretation
      ii. Implementation using Polyphase Structures
      iii. Multistate Implementation
   (b) Multirate Filter Banks
      i. Uniform Filter Banks
      ii. Quadrature Mirror Filter Banks
      iii. Digital Wavelet Transform

7. Application Examples

   **GOALS AND EXPECTED OUTCOMES**

   The goals of this course are to provide graduate students with an understanding of discrete-time signals and the analytical tools to analyze and design digital signal processing systems. Upon completion of the course, the students will be able to:

   1. design FIR and IIR digital filters to meet arbitrary specifications,
   2. develop algorithms to implement digital filters using MATLAB or other high level languages such as $C^{++}$,
   3. analyze tradeoffs associated with spectral estimation and filter design,
   4. develop and analyze algorithms for multirate digital signal processing, and
5. design and implement digital signal processing algorithms for applications related to digital communications, data acquisition, spectrum analysis, etc.

TEXT AND REFERENCES

The primary text for this course is


The following link is to the Mathworks page for books related to the use of Matlab

http://www.mathworks.com/support/books/

COURSE REQUIREMENTS AND GRADING POLICY

The semester grade will be based upon:

1. two semester exams (20% each for a total of 40%),
2. homework and computer assignments (25%), and
3. a final exam (35%),

DISTANCE EDUCATION STUDENTS

DE OFFICE HOURS

Office Hours for Distance Education Students: T 3:30-5pm or by appointment. Below are the recommended ways to contact me during DE Office Hours:

- Email: cmwilli5@ncsu.edu
- Office Phone: 919-513-1923
• Course Message Board

• Online Video Conference (e.g. Google Hangouts)

DE HOMEWORK ASSIGNMENT SUBMISSION

Homework should be submitted to the EOL office via the following avenues:

• Email: homework_eol@ncsu.edu or Fax: 919-515-8415

• Note: Due dates for homework assignments are the same as on campus due dates, which are listed on the course website

DE MESSAGE BOARD

A message board will be created for both on campus and DE sections of the course. This message board can be accessed at http://courses.ncsu.edu/ece513.

FURTHER DE COMMENTS

All other sections of the syllabus, unless otherwise stated, pertain to both on campus and distance education students.

NOTE TO ON-CAMPUS STUDENTS

Captured Lectures: This on campus course will be captured and distributed via the Internet and/or electronic media as part of the Engineering Online (EOL) program for the distance students. These video recordings may contain an image of you entering the classroom, asking a question or being a part of the studio class. Please notify Dr. Linda Krute, Director of EOL, in writing at ldkrute@ncsu.edu if you DO NOT want your image to be included in the lecture presentation. If we do not hear from you after the first week of the class, we will assume that you are in agreement with this procedure.

AUDITING POLICY
Students auditing this course must turn in all of the homework assignments. However, they are not required to take the two semester exams or the final exam.

**STATEMENT ON LATE AND MISSED ASSIGNMENTS**

All assignments must be turned in at the beginning of class on the date they are due. A penalty of 10 points per day will be assessed for all homework assignments turned in late. You are expected to turn your assignments in on time for any *anticipated* absences that you will have so please plan accordingly. Emergency or *unanticipated* absences will be handled on a case by case basis. There will be NO make up exams. Missing grades for missed exams with valid excuses and documentation will be replaced by the final exam grade. Students who believe they have valid excuses to miss assignments or exams must comply with University Attendance Regulations, see

http://www.ncsu.edu/policies/academic_affairs/courses_undergrad/REG02.20.3.php

A PC or any workstation may be used instead of the University computing system with appropriate software as follows:

1. Matlab (The student version of Matlab with the Signal Processing Tool Box is the minimum acceptable level)

2. Word Processor to prepare home work assignments in a presentable manner.

Also, see

http://www.ncsu.edu/it/essentials/your_computer/hardware_specs/

**COURSE LOCKER**
The Wolf Ware course locker for this course will be used to provide course notes, to provide additional information on the course, to make homework assignments, to provide examples, etc. You can obtain access to the course locker by using a Web browser such as Firefox or Internet Explorer. The URL for the locker is

http://courses.ncsu.edu/ece513/

STUDENTS WITH DISABILITIES

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services Services Office at Suite 1900, Student Health Center, Campus Box 7509, 515-7653.

http://www.ncsu.edu/dso/.

For more information on NC State’s policy on working with students with disabilities, please see

http://www.ncsu.edu/provost/hat/current/appendix/appen_k.html

ACADEMIC INTEGRITY

All the provisions of the code of student conduct apply to this course as appropriate. See

http://www.ncsu.edu/stud_affairs/osc/AIpage/acaIntegrity.html

COURSE EVALUATION

Students will receive an email message directing them to a website where they can login using their Unity ID and complete evaluations. All evaluations are confidential; instructors will never know how any one student responded to any question, and students will never know the ratings for any particular instructors.
Schedule: Online class evaluations will be available for students to complete during the last week of class during the following dates and times:

- TBA

Students will receive an email message directing them to a website where they can log in using their Unity ID and complete evaluations. All evaluations are confidential; instructors will not know how any one student responded to any question, and students will not know the ratings for any instructors.

Evaluation website: https://classeval.ncsu.edu/
Student help desk: classeval@ncsu.edu
More information about ClassEval: http://www.ncsu.edu/UPA/classeval/