

Course Title: COEN 4322: Digital Signal Processing

Semester Credit Hours: 3 (2,3)

I. Course Overview

The course presents an overview of the nature of signals, the algorithms and techniques used to process those signals and the applications to which digital signal processing can be usefully put.

II. PMU Competencies and Learning Outcomes

Students of COEN 4322: Digital Signal Processing develop the required mathematics to understand, implement and apply appropriate algorithms for signal processing as well as an understanding of the nature of signaling. This course is primarily theoretical and conceptual in nature with a strong practical implementation component. Students are expected to be able to design and implement solution to signal processing problems and to communicate those solution to their peers and to lay clients. Students are expected to work both individually and in groups to achieve common objective. Students have the opportunity to enhance their adaptability, group effectiveness and communication skills.

III. Detailed Course Description

COEN 4322: Digital Signal Processing is concerned with developing and understanding of the concepts underlying digital signal processing. The concept, structure, organization and characteristics of signals are discussed with an examination of the spectrum of periodic signals and the frequency domain and the distinction between signal and noise, the causes of noise and the effects of noise and other factors on signal quality. Techniques for processing signals are examined including filtering and non-filtering processes. Architecture and algorithms for signal processing are presented; graphical and spectral analysis, fast Fourier transforms and the underlying concepts of digital signal processors. Example applications for digital signal processing are presented including communication signal processing, speech signal processing and sound signal processing.

IV. Requirements Fulfilled

This is a required course for all computer engineering majors. It may be used as an elective in the computer science degree program. This course should be taken in the senior year.

V. Required Prerequisites

COEN 3322: Signals and Systems

VI. Learning Outcomes

In this course, students learn:

- To develop an understanding of the nature of signals and the limitations that media characteristics place on the utility of those signals.
- To develop expertise in the design and implementation of applications for the solution of digital signal processing problems.
- To become familiar with a variety of common DSP developmental tools.
- To be able to discuss the strengths and limitations of DSP applications in solving signaling problems with both professional peers and lay clients..
- To develop improved communication and group effectiveness skills.

VII. Assessment Strategy

The course grade involves an assessment of student performance on examinations that focus on the understanding of various concepts and constructs underlying Digital Signal Processing, and the communication of those concepts and the characteristics of designed solutions to DSP problems to an audience. Course grades are based on:

- Weekly assigned homework to motivate students to do the work and earn credit accordingly.
- Weekly, in-class presentations by students related to independent literature research on aspects of the course material and classroom discussion and critique of the presentation.
- Two in-class examinations to assess the student's accumulative mastery of content covered prior to the time of the examination.
- Three major programming assignments to test the student's understanding of the major concepts introduced during the course. Each programming assignment is assessed through instructor and peer review during in-class presentations.
- A comprehensive final examination to assess the student's accumulative mastery of course material.

The final grade is based on 10% credit for the homework, 10% for the presentations and participation in classroom discussion, 20% on in-class examinations, 40% on programming assignments and 20% for the final examination.

Students are required to maintain a journal of thoughts and commentaries during the course. The journal contains daily entries including the identification of areas of interest and concern, notes on the preparation of presentation and comments and analysis of classmate's presentations. The journal is reviewed weekly by the instructor to provide feedback to the students.

Final grades and the student and instructor observations from reflective notebooks are included in the student's portfolio for use in the final assessment capstone course. The intent is to document the student's maturation as he proceeds through the curriculum.

VIII. Course Format

This course is a combination of lecture/discussion and laboratory use. Students are expected to attend two hours of lecture/discussion per week and to be available in a dedicated laboratory facility for three hours per week during which they should expect to undertake significant independent experimentation with DSP development tools.. Once a week students should have at least 30 minutes of collaborative problem solving activity.

Classroom Hours (5 hours per week)

Class: 2

Lab: 3

Web supplement: Course home page (the university's Web tool, WebCT or Blackboard) should contain the following:

- Course syllabus.
- Course assignments.
- Sample solutions to examinations (after graded and returned).
- Course calendar (an active utility).
- Course e-mail (an active utility).
- Course discussion list (an active utility).
- Student course performance (an active utility).

IX. Topics to be Covered

- A. Signal analysis
 - a. Signals
 - b. The spectrum of periodic signals
 - c. Frequency domain
 - d. Noise
- B. Signal processing systems
 - a. Systems
 - b. Filters and non-filters
 - c. Correlation
 - d. Adaptation
 - e. Biological signal processing
- C. Architectures and algorithms
 - a. Graphical techniques
 - b. Spectral analysis
 - c. Fast Fourier transform
 - d. Digital filters
 - e. Function evaluation algorithms
 - f. Digital signal processors
- D. Applications
 - a. Communication signal processing
 - b. Speech signal processing

X. Laboratory Exercises

There is a three-hour per week laboratory component to this course. The laboratory is not a structured time, but an opportunity for the students to work with DSP tools and hardware. There is no designated curriculum for laboratory exercises.

XI. Technology Component

This course makes use of the university's wireless access infrastructure. The course relies on the university and the students having access to professional grade application development environments for the students to use. The course's laboratory component requires dedicated signal processing hardware and tools within one of the university provided computer laboratories.

XII. Special Projects/Activities

Students are required to keep a "reflective notebook" in which, after each class, they enter their own assessments of what they learned, and what questions remain from the class. From each exercise set, each student selects one problem, which the student thinks best reflects the way the mathematical topic is used in a technical context. A detailed solution to the problem is included in the student's reflective notebook.

Students are expected to develop three DSP assignments during the semester that include software engineering design, implementation and documentation. These assignments are group assignments determined through negotiation between the group and the instructor. The laboratory time provided in the course provides the majority of the time required for implementation with additional hours outside laboratory time available for the students on a group basis as required.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Proakis, J.G. & Manolakis, D., *Digital Signal Processing: Principles, Algorithms and Applications* (3rd Ed.), (1995) Prentice-Hall
ISBN: 0-133-73762-4

B. Alternative Textbooks

None

C. Supplemental Print Materials

None

D. Supplemental Online Materials

As available from publisher.