Course Description

CET4190C | Applied Digital Signal Processing | 4.00 credits

This is an upper division level course for students majoring in electronics engineering technology. Students will learn how to model digital signal processing (DSP) systems, apply the Z transform, and develop algorithms for convolution, correlation, the Discrete Fourier Transform (DFT), and the Fast Fourier Transform (FFT). Students will apply these concepts in the design and implementation of digital filters and DSP algorithms in an embedded system. Prerequisite: CET3126C.

Course Competencies:

Competency 1: The student will demonstrate an understanding of the DSP development platform by:

1. Describing the embedded processor and the micro-signal architecture
2. Discussing the concept of real-time embedded signal processing
3. Configuring the integrated development environment (IDE) for developing and deploying DSP algorithms
4. Verifying the functionality of the processor and the on-board DSP in on embedded board, such as the Beagle Board or other DSP board, by configuring, installing, and testing the operating system and associated DSP libraries

Competency 2: The student will demonstrate an understanding of time-domain signals and systems by:

1. Describing the concept of a time-domain digital signal
2. Discriminating between periodic and random signals
3. Developing basic digital filters
4. Implementing and testing basic filters in a real-time embedded DSP system

Competency 3: The student will demonstrate an understanding of frequency-domain analysis and processing by:

1. Describing the Z-transform and its application to digital filtering
2. Applying frequency analysis through the frequency response of a digital system
3. Implementing the Discrete Fourier Transform (DFT)
4. Implementing the Fast Fourier Transform (FFT)
5. Describing and implementing the concepts of windowing functions

Competency 4: The student will demonstrate an understanding of digital filters by:

1. Discussing the ideal filter and practical filter specifications
2. Analyzing the characteristics, implementation, and design
3. Describing the structure, algorithms, and design concepts of adaptive filters
4. Describing an adaptive line enhancer in a real-time embedded DSP system
5. Implementing FIR and IIR filters in a real- time embedded system
6. finite-impulse response (FIR) filters, and infinite-impulse response (IIR) filters

Competency 5: The student will demonstrate an understanding of embedded signal processing systems and concepts by:

1. Describing the embedded processor, its architecture, and its applications
2. Analyzing real-time DSP fundamentals and implementation considerations such as number formats, dynamic range, precision, and quantization errors
3. Using the instruction set of the digital signal processor
4. Using the memory system and data transfer using the Blackfin processor
5. Applying code optimization techniques and power management in the Blackfin processor
6. Implementing practical DSP applications such as audio coding and audio effects and image processing algorithms

Competency 6: The student will demonstrate the ability to design a DSP system to perform an engineering application by:

1. Developing a DSP project proposal
2. Analyzing, designing, building and testing a DSP project that performs an engineering application that has been reviewed and accepted by the instructor
3. Demonstrating the project function to the original specifications
4. Writing a project document including the following sections: introduction, background/theory, design explanation, schematics and code, testing, discussion and conclusion

Learning Outcomes:

- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Use computer and emerging technologies effectively