

# **SAMPLE SYLLABUS**

This syllabus is to be used as a guideline only. The information provided is a summary of topics to be covered in the class. Information contained in this document such as assignments, grading scales, due dates, office hours, required books and materials may be from a previous semester and are subject to change. Please refer to your instructor for the most recent version of the syllabus.

## ABET Course Syllabus EEE404

1. **Course: EEE 404 Real-Time Systems**
2. **Credits and Contact Hours:** 4 Credit Hours (lecture, lab), Topics: Engineering
3. **Course Coordinator:** Systems Area Committee
4. **Textbook:** S.M. Kuo, B.H. Lee, and W. Tian, *Real-Time Digital Signal Processing: Implementations and Applications*, 2nd edition, John Wiley & Sons, 2006.  
**Supplemental materials:** None
5. **Specific course information**
  - a. **Catalog description:** Design and implementation of real-time software for embedded systems through the programming of Digital Signal Processors (DSPs), with emphasis on fixed-point DSPs. This course provides hands-on experience in translating signals and systems concepts into real-time multimedia and communications applications.
  - b. **Prerequisites or co-requisites:** CSE100, CSE/EEE230, EEE203.
  - c. **Required/elective/selected elective:** Elective
6. **Specific goals for the course**

To gain experience using equipment commonly used in industry and in consumer product development such as digital signal processors, Analog-to-Digital and Digital-to-Analog converters, function and signal generators. To gain the skill of translating signals and systems concepts into real-time software using digital signal processor technology. To gain the skill of working with integer (fixed-point) arithmetic and dealing with finite-wordlength effects. To develop multimedia and communication applications by implementing them on actual hardware in real-time. To gain the skill of optimizing the real-time performance based on the used processor architecture. To gain the ability of interfacing the processors to peripherals and external devices for test and measurement. To gain hands-on experience in acquiring, analyzing, and processing real-time I/O.

  - a. **Outcomes of instruction:**
    - Students can translate basic signals and systems concepts into real-time software for various applications.
    - Students can develop real-time C and Assembly language software optimized for the selected DSP architectures with emphasis on fixed-point DSPs.
    - Students can interface the processors to external devices for test and measurement and I/O.
    - Students can use tools to debug and profile the performance of the developed software.
    - Students can develop floating-point and fixed-point real-time implementations.
    - Students can work effectively on team-oriented design projects.
  - b. **Outcomes of Criterion 3 addressed by the course:**
    - (1) Students work on engineering problems that involve advanced mathematical concepts with modern tools that are relevant in applications.
    - (2) Students will design components and systems for real-time multimedia and communications applications
7. **Brief list of topics to be covered**
  1. Real-Time Systems: Introduction and Basics
  2. Basic Concepts in Signals and Systems: signals, Analog-to-Digital/Digital-to-Analog conversion, sampling and aliasing, quantization, discrete-time representation, filtering

3. Digital Signal Processor Architectures: Harvard architecture, special addressing modes, parallel instructions, pipelining, real-time programming, modern digital signal processor architectures, hardware interfacing.
4. Computer Arithmetics: fixed-point and floating-point numbers and arithmetic
5. Finite-wordlength effects: quantization, overflow, saturation, scaling, rounding and truncation
6. Fixed-point Digital Signal Processors
7. Fast Fourier Transforms and Applications: DTFT, DFT, FFT, implementation complexity, linear convolution, circular convolution, fast convolution, Short-Time Fourier Transform and Spectrogram
8. Real-Time Multimedia and Communication Applications: speech processing, and/or audio processing , and/or image processing, and/or adaptive filtering, and/or modulation/demodulation, and/or matched filtering, and/or equalization.

### **Laboratory Work**

Lab: On-campus students meet weekly for a three-hour laboratory session under the guidance of a TA. On-line students can access the lab equipment, boards, and software remotely in real-time, and can develop and run real-time applications from their remote location using the lab equipment, hardware, and software through a user-friendly “virtual bench” interface. Course (lectures and labs) can be taken on-line; more information at <http://cpd.asu.edu>

**Course Contribution to Engineering Science and Design:** Students work on open-ended problems both as part of the homework and as part of the laboratory exercises. Course involves design and implementation of real-time computer-based systems using modern software and hardware.

Person preparing this description and date of preparation: K. Tsakalis, June, 2021.