NSF Project Summary

As students go through a traditional ECE program, they learn a lot about individual components (transistors, op amps, diodes, resistors, transmission lines, and Fourier transforms). In a traditional lab, they build and test these individual units. But when the lab is done, whether or not it worked, they can more or less “forget it”. And when the class is finished, they stash their notes and move on to the next subject, often forgetting much of what they have learned. In spite of all of our lecturing, students often do not see the relevance of what they are supposedly learning, do not see how it fits into a system, do not see how they will ever use it. Their motivation suffers, their grades droop, and the bright, energetic, creative and optimistic student becomes mired in a morass of incomprehensible abstraction, ..... before transferring to the business college.

Imagine if instead, from first day of class, students are challenged to build a simple but complete system using most of the concepts they will learn in the class. Piece by piece they learn about the components they need, design and test them, perhaps good-naturedly competing with their fellow students for the best designs. When they ask if their designs are “good enough”, they are encouraged to check it out for themselves... and predict how it will affect their system in the end. At the end of the semester, the systems are integrated and tested, and virtually all of the designs work, of course! The students were excited and motivated, and if a part didn’t work, they were anxious to fix it. In some cases, systems from two or more courses are integrated together, reminding the students what it was that they learned last semester. And when the students go home for Christmas break, they are proud and excited to tell their friends and family about the “widget” they created, and the late-night stories of how they creatively modified this or that until the design worked much better than before. This is the student experience in a curriculum that thoroughly integrates system-level design throughout the curriculum, and that is exactly how we want our department to be.

In this project, we propose to enhance the strong laboratory component within the ECE program at the University of Utah by developing system-level design projects to be integrated within individual courses and also spanning multiple courses. This builds on a particular strength of the department, which already has a top-notch industrially sponsored senior design sequence and a few courses with strong system design projects. Through this change, we expect to (1) increase student recruitment and retention (hopefully including diverse students who might otherwise not have chosen or stayed in engineering), (2) increase student motivation (system design projects are FUN), (3) increase knowledge acquisition and retention (because you can’t forget something that you need to integrate at the end of the semester and perhaps next semester too), and (4) develop system-level design understanding (the formal training of which is very limited within ours and other traditional engineering curricula).
The novel aspects of this proposal include the projects themselves, the methods and concepts of integrating multiple classes within the curriculum, and the methods to assess and implement these projects. Undergraduate students, graduate students, and faculty will work together to build this new program within our department.

The University of Utah and the bevy of other traditional state schools in the nation have a tremendously broad impact on the engineering workforce. The novel system-level projects that are developed here will be transitioned to other programs, and have the potential to make a significant change in how engineering is taught and the capabilities of our graduates. The University has provided support for this project through grants of TA funding and equipment for curriculum development, and the agreement to provide a permanent lab technician specifically to facilitate new lab projects. We are already creating a few new system-level design projects for this fall, and we hope that NSF will provide the support to make the exciting small changes that are underway into a dramatic, full-scale improvement in the ECE curriculum. The UofU ECE department is in the mood for change, with a young faculty, a collaborative vision, and the earnest desire to provide a top-notch hands-on system design program for our ECE students and those throughout the nation. We think we can make a difference, and we hope that you will help to facilitate the vision of an exciting ECE curriculum fully integrated through system-level design projects.