1. What is this course about?

EE497 is designed as a bridge between the theory and application. While certain amount of time is devoted to explain the theoretical concepts, more time is devoted to the applications in MATLAB and in myRIO. Hence the main target in EE497 is to introduce students to the practical applications of Digital Signal Processing in embedded systems. In this respect, experiments are carefully selected so that the background established throughout this course can be easily used in engineering companies as well as for the graduate study in a university.

2. Which part takes more time, theory or the application in this course?

In this course, some useful and to the point applications of Signal Processing are implemented both in MATLAB and in real-time embedded system, myRIO. Hence theoretical parts related to the applications are presented such that the students will be able to implement the idea easily. Remaining time is devoted to the implementation in MATLAB and embedded system. In this respect, this course devotes more time in the laboratory for the implementation of real world problems.

3. Who should take this course?

EE497 is trying to eliminate the time it takes for graduates to start contributing in their future jobs. In this respect, significant amount of time is devoted to introduce the students to the state-of-the art digital systems for implementing Signal Processing theory. Hence those students who take this course are expected to get a good understanding of embedded system structures and techniques to implement the signal processing systems. Therefore students who would like to have such a background should take this course. Note that this background is not easily acquired and students are expected to spend several hours for implementing practical embedded systems.

4. How would be the grading?

The grading percentages are given in the syllabus. However you should note that your performance is evaluated in the laboratory. That is, you would be graded based on what you achieve and show in the laboratory.

5. How much time should I spend for a reasonable grade in this course?

This depends on the student's background. If you have a very good background in embedded systems and MATLAB, then it should not take a significant amount of time. But if you have no background in Signal Processing and digital systems, then there are lots of things you should learn and hence spend significant amount of time. Good part is, you can always ask questions and trace back your problem to quickly solve it.

6. What kind of hardware is used in this course?

NI myRIO is the device used in this course for implementing the Signal Processing systems in real-time. You can find detailed information in this link http://www.ni.com/pdf/manuals/376047a.pdf. myRIO is based on Xilinx Zynq-7010 system-on-chip (SOC) architecture. It has dual-core 667 MHz ARM Cortex A9 application processor unit (APU) so that you can realize floating-point operations. It also includes Artix-7 FPGA so that you can program analog input-output ports and transfer samples through DMA for the cpu operations. myRIO has 4 analog inputs in MXP A and MXP B expansion ports. There is an on-chip 12-bit A/D converter at a 500 kS/s aggregate sampling rate to sample all the analog input channels. It also includes audio input and output ports. myRIO can be

connected to your PC through a USB cable. In summary, this course will allow students to program an embedded system with a floating-point processor and a FPGA.

7. Which software is used in this course?

EE497 is based on both MATLAB and LabVIEW implementations. The experiments are first implemented in MATLAB in order to easily see the results and waveforms. Then the Signal Processing system is implemented in myRIO using both its cpu and FPGA. LabVIEW is used to program myRIO. You can find some information on LabVIEW in this link http://www.ni.com/labview/.

8. Do I need to know LabVIEW before taking this course?

No. You will learn LabVIEW during this course. LabVIEW is a graphical programming environment where mathematical operations are implemented using graphical icons in the library. It is similar to MATLAB Simulink in a way but it is more advanced. It is assumed that students know MATLAB before they take this course.

9. What is the difference between MATLAB and myRIO implementation?

Many practicing engineers point the “idea-to-implementation gap.” Idea and the algorithm is usually developed in MATLAB due to its rich features and functions as well as its simplicity. As the design moves toward embedded implementation, real-world constraints should be taken into consideration. Hence a practicing engineer should know how to implement the idea in an embedded system.

In MATLAB, you implement Signal Processing systems with double precision (64-bit) floating-point representation. In embedded systems, this is usually not possible and there are certain artifacts due to lower precision. Hence you need to take appropriate actions to avoid the problems associated with this. Furthermore, MATLAB implementations are usually not real-time. Therefore, computationally intense operations can be performed without any problem except you wait longer. In an embedded system like myRIO, the same program simply does not run due to limited resources. Hence you need to simplify the operations and choose computationally efficient alternative approaches. MATLAB implementation in general cannot be used except for verification. Any commercial product should use resource limited embedded systems for real-time implementations. As a result, there is a significant difference between implementing a system in MATLAB and myRIO. This course introduces students to the practical system realizations so that they acquire the background to move their ideas to a real-time embedded system.

10. What is the difference between this course and a course which teaches microprocessors?

In this course, the main target is to introduce students to real-time applications of Digital Signal Processing. Hence, LabVIEW and myRIO are considered as tools to reach this goal. Several details related to embedded system hardware and software are outside the focus of this course.

11. There are some advanced topics in the course. What is the depth of coverage for such concepts?

All the required details for implementing real-time applications are covered in this course in a simple scenario. Since these topics cannot be fully covered with a course like EE497, we will only focus on the applications and hence several details are kept outside the focus of this course.

12. What is real-time application?

In real-time application, a program executes in a time duration that the user senses as immediate. Usually this time duration or latency is less than a predefined value which depends on the application. For example, in audio processing if your program executes less than 20 ms, then you would not sense the difference and hence your application becomes real-time.