

University of Southern California  
Viterbi School of Engineering  
Ming Hsieh Department of Electrical Engineering

**EE505b – Analog, Mixed Signal, and RF Integrated Circuit Measurements (EE599 for Spring 2024)**  
**Course Syllabus**  
**Spring 2024**  
**4 units**

**Note: The prerequisite is EE505a, but students with a strong background in EE477L and/or EE536a may send an email to the instructor (schober@usc.edu) for an exception if they desire to learn more about PCB design and testing for Analog, Mixed Signal, and RF ICs.**

### **Abstract**

EE505b is an introductory analog, mixed signal, and radio frequency (RF) integrated circuit (IC) measurement class. This class concerns the characterization of devices and circuits designed and fabricated in the previous EE505a tapeout course which employed TSMC 180nm CMOS technology. Students will work together in teams to build test bench designs for the returned fabricated IC which included MOSFETS, resistors, capacitors, inductors, transmission lines, transimpedance amplifiers (TIA), operational amplifiers (OpAmp), and voltage-controlled oscillators (VCO). If students have done extra individual designs such as an analog to digital converter (ADC) in EE505a, then that will also be tested. Printed circuit boards (PCB) will be created by students using software such as Autodesk's Eagle/Fusion 360 (to be decided) and fabricated. The returned IC from the previous EE505a to be experimentally measured will be wire-bonded, packaged, and mounted on the PCB with other parts ordered and soldered onto it as needed; then it will be physically tested for various parameters. Measurements to be done include DC current, voltage, and power device specifications, and other analog, mixed signal, and radio frequency related measurements that may be essential for the various devices/circuits using the required laboratory equipment such as an oscilloscope, vector network analyzer, spectrum analyzer, etc. At the end of the semester, students will present and report the specifications in corresponding data sheets for each measured device/circuit to be reused for future EE505ab classes circuit libraries.

### **Course Administration**

EE505 is a 2 hour "studio" format on Tuesdays and Thursdays in which lecture is taught in the first part of class on Tuesdays and Thursdays led by the instructor and the students then can work on their assigned projects in the second part of the class with the help of the Teaching Assistant (TA) and Professor and/or give present their project updates, all in the same setting. All classes meet in OHE230 from 12:00-1:50pm. The class will be recorded on Zoom via Blackboard so students can review the lecture and participate remotely as needed. Students will also be given access to OHE240 so that they can work on their designs at other times. **The prerequisite is EE505a, but those with EE477L and/or EE536a may send an email to the instructor for an exception if they desire to learn more about PCB design and testing for Analog, Mixed Signal, and RF ICs.**

## Grading

The EE505b grade is based on the following components which include the design and testing of the following test benches and resulting data sheets which will report the specs:

**Project 1:** MOSFET, Resistor, Capacitor, Inductor, and Transmission Line Test Bench and Data Sheet: 20%

**Project 2:** Transimpedance Amplifier (TIA) Test Bench and Data Sheet: 20%

**Project 3:** Fully Differential Operational Amplifier with Digital Clocking (OpAmp) Test Bench and Data Sheet: 20%

**Project 4:** Ring Voltage Controlled Oscillator (VCO) w/Resistor, Capacitor, and/or Inductor Cross-Coupling Test Bench and Data Sheet: 20%

**End of the Semester Project Presentation/Final Design Review:** 20%

Teams will be assigned for each of the projects, but each student must turn in their own version of the project reports/datasheets listed above.

The TA and instructor will help monitor a Blackboard EE505b discussion board where you can post any questions you have regarding the projects, so that everyone, including all students can help answer any issues that may arise with Cadence, the process design kit (pdk), the PCB software, the soldering in lab, etc. as we go together through the semester. We ask that you first post in the discussion board to ask any questions or share information you may encounter that can help others here instead of emailing directly the TA and Professor if it has to do with work on the assigned projects.

Apart from numerical grades for the assignments above, final class letter grades will be posted on Blackboard by May 5, 2024. It is the student's responsibility to verify (and possibly contest) these grades **before** the grade deadline on May 8, 2024. **Once assigned, a letter grade will not be changed except for grossly erroneous circumstances.**

The last day to drop the class without a W grade is February 23, 2024, without a refund (January 26, 2024, with a refund). The last day to drop the class with a W is April 6, 2024. Incomplete grades (IN) are rarely assigned. The IN grade may only be justified in exceptional cases such as student illness or a personal tragic event that occurs in the semester. Visit <https://classes.usc.edu/term-20241/classes/ee/> for more information.

**Instructor Information**

Susie Schober

schober@usc.edu

PHE628

Office Hours: Tuesday and Thursday after class in OHE230

**Teaching Assistant**

TBD

The EE505b/EE599 website is located on [blackboard.usc.edu](https://blackboard.usc.edu).