Instructors:

Prof. Leburton is the course director. Professors that have taught ECE 340 in the past include Prof. Pop, Liu, Gilbert, Carney, Fang, Mohamed and Tucker, to name a few. Most professors who teach this course specialize in device physics or nanoelectronics.

Prerequisites:

Officially PHYS 214 is listed as a prerequisite, while ECE 329 is listed as a pre-/co-requisite. ECE 340 involves many physics concepts such as diffusion and particle distribution, so having completed PHYS 213 is almost as important as PHYS 214. In fact, several PHYS 213 lectures cover semiconductor physics at a basic level. The first part of ECE 340 will involve various topics from PHYS 214 such as the concept of discrete energy levels, and a brief discussion of Schrödinger's Equation and its consequences in semiconductors. Relevant topics from ECE 329 include Maxwell's equations in material media and carrier mobility. They apply in ECE 340 to topics such as p-n junctions and carrier flow, but should be covered early enough in the semester if taken concurrently with ECE 340. Overall, these courses are most helpful in developing an intuition for what is happening at the physics level inside electronic devices.

When to Take It:

Taking this course in accordance with the stated prerequisites and co-requisites is especially important for ECE 340, due to its emphasis on conceptual understanding. Because of the overlap with physics concepts, it is best to take this as soon as possible after the prerequisites. This course is a gateway to many other courses in electrical engineering such as electronic circuits and IC fabrication, and in physics. It is beneficial for students considering careers in anything to do with physical and quantum electronics and circuits to take ECE 340 as early as possible.

Class Content:

Much of the theory discussed in ECE 340 can be traced back to discoveries made in ECE at Illinois. The material in ECE 340 is cumulative in a very clear-cut manner; new topics build on previous topics continuously in the course. In the beginning, students are introduced to semiconductor physics with crystal lattice structures, doping, energy band diagrams, and carrier drift and diffusion. These topics form the theory and math needed to cover the next section of p-n junctions and diodes. P-n diodes are then used in understanding the physics behind bipolar junction transistors and finally metal-oxide transistors, the last topic covered. Recent changes to the course have emphasized theory and concepts over equations and rigorous math. Therefore this course is similar to physics courses in that it is essential to have an understanding of the concepts and not just the equations. In fact, part of the conceptual understanding involves recognizing when various approximations can be made that simplify analysis and calculations. This includes the effects of heavy doping or ignoring the effects of recombination of carriers.

Work:

Homework assignments are assigned each week and usually consist of three or four problems that may involve drawing band diagrams, derivations, calculations, conceptual explanations, or using an online semiconductor simulation applet. It is important to keep up with the material and attend class because several unannounced quizzes are offered throughout the semester. Many of the homework and exam problems are very similar to those in the textbook. Therefore, it is advisable to do work beyond the homework in order to prepare for exams. There are often several different sets of lecture slides and online texts on the course website that are helpful if the student needs a slightly different explanation of some difficult material.

Life After:

Not surprisingly, ECE 340 is the prerequisite to many courses in the area of solid-state electronics, including ECE 441 (Physics and Modeling of Semiconductor Devices), ECE 444 (Theory and Fabrication of Integrated Circuits), and ECE 482 (Digital IC Design). Taking ECE 342/343 (Electronic Circuits) either before, concurrently, or after ECE 340 provides a good overview of electronic circuits at both the device and circuit levels.