Engineering Faculty Document No. 52-06
May 10, 2007

TO: The Faculty of the College of Engineering
FROM: The Faculty of the School of Electrical and Computer Engineering
RE: ECE 656 Changes in Course Description, Terms Offered and Content

The faculty of the School of Electrical and Computer Engineering has approved the following title changes of the undergraduate level course, ECE 656. This action is now submitted to the Engineering Faculty with a recommendation for approval.

From: **ECE 656 – Electronic Transport in Semiconductors**
Sem. 1 and 2. (Offered every third semester.) Class 3, Cr. 3.
Prerequisite: ECE 606. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

A treatment of the microscopic and phenomenological physics of carrier transport in bulk semiconductors and in semiconductor devices. The Boltzmann transport equation is introduced as are techniques for solving it analytically and numerically. The physics of carrier scattering in common semiconductors is explored. Theoretical treatments of low and high field transport are compared with measured results. Balance equations are derived as moments of the Boltzmann Transport Equation and are applied to the analysis of sub-micron semiconductor devices. Students are expected to be able to apply elementary concepts of quantum mechanics and solid state physics.

To: **ECE 656 – Electronic Transport in Semiconductors**
Sem. 1, odd years. Class 3, Cr. 3
Prerequisite: ECE 606.
Prerequisites by topic: Elementary quantum mechanics, basic understanding of semiconductor physics and devices

The course consists of three parts. Part 1 focuses on ballistic (and quasi-ballistic) transport – both semiclassical and quantum. Part 2 focuses on traditional low-field transport theory based on the Boltzmann Transport Equation. It treats drift-diffusion charge transport as well as thermoelectric effects (heat flow and temperature gradients) and galvanomagnetic effects (magnetic and electric fields). Part 3 examines, high-field transport – first in bulk semiconductors to explain phenomena such as velocity saturation and then in small devices where electric fields change rapidly and effects such as velocity overshoot arise.

Reason: The course description and content have been changed to reflect the updated content of the course.

Mark Smith, Head
School of Electrical & Computer Engineering

ECE 656 – Electronic Transport in Semiconductors

Required Text(s): *Fundamentals of Carrier Transport*, 2nd Edition, Mark Lundstrom, Cambridge University Press, © 2000; ISBN 0-521-63134-3

Lectures	***Principal Topics***
6	Review of essentials of semiconductor physics
8	Semiclassical ballistic transport
3	Quantum ballistic transport
9	Low-field, diffusive transport
3	Balance Equations
1	Monte Carlo Simulation
8	Carrier Scattering
2	High-field transport in bulk semiconductors
2	Off-equilibrium transport in devices