Title: Scaling of High Frequency III-V Transistors

Course Description /Abstract: Electron device bandwidths continue to increase rapidly, with Si MOSFET cutoff frequencies now exceeding 400 GHz and InP transistor bandwidths being presently approximately 1 THz. We will examine the design of both InP bipolar and field-effect transistors for application at the highest frequencies. Performance metrics relevant for digital, mixed-signal, and RF circuits will be developed, device high-frequency parasitics defined, and cutoff frequencies calculated. Scaling laws necessary for proportional improvement in all device high-frequency properties will be derived for both HBTs and FETs. Present challenges in device scaling will be considered in detail, in particular the effects of geometry, semiconductor-metal and semiconductor-dielectric interfaces, thermal resistances, and fringing capacitances. We will consider appropriate revisions to device fabrication process flow, including dry-etch processes for junction definition, blanket sputter / dry-etch processes for contact definition, and planarization and dielectric sidewall processes for contact alignment. Methods, and challenges in high-frequency transistor characterization will be discussed, and design of 100 + GHz IC interconnects addressed.

Intended Audience:
MS/Ph.D. students and researchers of M.S. or Ph.D. level education active in semiconductor research.

Biography:
Mark Rodwell (B.S., University of Tennessee, Knoxville, 1980, M.S. Stanford University 1982, Ph.D. Stanford University 1988) is Professor and Director of the UCSB Nanofabrication Laboratory and NSF Nanofabrication Infrastructure Network (NNIN), and the SRC Nonclassical CMOS Research Center at the University of California, Santa Barbara. He was at AT&T Bell Laboratories, Whippany, N.J. during 1982-1984. His research focuses on very high frequency transistors and integrated circuits. Current efforts include THz InP bipolar transistors, compound semiconductor field-effect-transistors for VLSI applications, and mm-wave and sub-mm-wave integrated circuit design in both silicon VLSI and III-V processes. He was the recipient of a 1989 National Science Foundation Presidential Young Investigator award, his work on GaAs Schottky-diode ICs for mm-wave instrumentation was awarded the 1997 IEEE Microwave Prize, and he was elected IEEE Fellow in 2003.