THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Fundamentals of Power Management Integrated Circuits for VLSI Systems

ECE 5227

Credit Hours:
4.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate (5000-8000 level)

Course Components:
Lecture
Lab

Course Description:
Theory, design and applications of integrated power management integrated circuits in VLSI systems. This includes: system and circuit architectures, performance metrics, practical implementations, design considerations in VLSI systems in advanced CMOS processes, and design techniques for integrated power regulators and battery chargers. Background in basic analog design is strongly recommended.

Prerequisites and Co-requisites:
Prereq: 4021, or Grad standing in Engineering or Physics.

Course Goals / Objectives:
- Master the various power delivery schemes in VLSI systems and the definitions of power management integrated circuits performance metrics and how they are measured.
- Be familiar with the challenges facing power management integrated circuits.
- Master the design techniques, performance tradeoffs, and small-signal/large-signal analysis of linear and switching power regulators.
- Be competent in the use of modern integrated circuit design CAD tools and in performing AC, DC, and Transient simulations.
- Be competent in writing design reports.
- Be competent in performing lab characterization of power management integrated circuits.

Course Topics:

- Basic definitions, main tasks of power management systems, challenges facing the implementation of power management circuits in VLSI systems, power distribution schemes in mixed-signal SoCs, typical load types.
- Performance metrics of power management circuits.
- Steady-state operation of step-down power regulators.
- Voltage-mode control techniques of step-down power regulators.
- Small-signal modeling and compensation techniques for step-down power regulators.
- Current-mode and other control techniques for step-down power regulators.
- Loss mechanisms and modeling in power regulators.
- Implementation examples of step-down power regulators.
- Steady-state operation and small-signal modelling of step-up (boost) power regulators.
- Buck-boost, forward, and fly-back power regulators.
- Battery chargers
- Introduction to lab characterization of power management integrated circuits
- Lab characterization of integrated linear regulators
- Lab characterization of step-down switching regulators
- Lab characterization of step-up switching regulators

Designation:

Elective